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THE NEWEST ELECTRICAL INVENTION.

A most extraordinary device has been completed by two inventors of one of the eastern states, if we may trust the newspaper account of it. This device is so revolutionizing that it is going to "place Marconi and De Forest on the junk heap," and goodness knows what it will do to their apparatus. In brief, it is a telephone instrument which enables any person, when writing, walking or moving about in any way whatever, to put himself in communication with any telephone system. Very properly, this wonderful instrument is called the "runo-walko-rideo-driveo universal telephone," or words to that effect, and it is said that it is so marvelous that the inventors have found it necessary to simplify it very greatly in order that the experts of the great telephone companies of the country can understand it. It seems, however, that they have another difficult problem before them, which must be solved before their instrument is a commercial success. There is, as yet, no way which enables the exchanges with which connection is made to collect tolls from the users of the new instruments. There would seem also to be another very important problem which is awaiting solution, that of convincing the dull telephone experts mentioned above of the practicability of the new device.

THE TELEPHONE RELAY.

The newest solution of the old problem of devising a telephone relay has been offered by Dr. John Trowbridge, in the instrument described in the last issue of the ELECTRICAL REVIEW. Certain new principles have been employed in constructing it which, it is said by the inventor, overcome the difficulties met in previous designs.

Two great difficulties have always bothered the inventors of telephone relays. One of these is the so-called growling or crackling noise which is produced by the instrument when the microphone transmitter is used for amplifying the signals. The other difficulty has been to secure independent adjustment of the receiving and transmitting portions of the device. The former difficulty is overcome in the present instrument by placing the moving part of the receiver, which is a light laminated electromagnet, in a balanced magnetic field and by keeping the centre of the diaphragm of this part of the instrument free from pressure. To transmit the vibrations of this part of the instrument to the microphone, the movements of the outer edge are utilized and not those of the centre, and these vibrations are transmitted through metal and not through air, which is a poor transmitter. Further, this construction does not interfere with the motion of the diaphragm. This metal transmitter is brought in contact with the microphone transmitter, and the pressure between the two can be adjusted without interfering with the adjustment of the receiving part. This means of transmitting the vibrations of one part of the instrument to the other is new, and upon it, it is said, the success of the instrument largely depends. Dr. Trowbridge has found that, in the laboratory, excellent results are obtained with it.

A satisfactory telephone relay would, of course, greatly benefit the telephone art, as it would not only increase the ordinary distance of communication, but would assist in reducing the cost of the transmission line. Such a device would be the more welcome to-day, as other proposed methods of improving telephone transmission do not seem to have made as much headway as was expected. It does not seem, however, that any form of relay in which moving parts are employed can be applied to

submarine work, except, of course, in cases where the relay itself would be placed above water. It is out of the question to place any instrument which requires adjustment from time to time under water.

THE UTILITY OF ELECTRICAL PYROMETERS.

For the recent James Forrest lecture delivered by Mr. R. A. Hadfield before the Institution of Civil Engineers, of Great Britain, the speaker took as his subject "Unsolved Problems in Metallurgy," and during an interesting discourse on this topic he pointed out the necessity for accurate temperature determinations. For instance, a common ordinary carbon steel was mentioned which hardens at a certain temperature. But it has only recently been discovered that the dividing line at which the metal becomes hard or not is only a few degrees; indeed, one authority says not more than one degree centigrade. This particular metal, when heated to 725 degrees centigrade and quenched in brine, will bend, cold, forty-three degrees, and its Brinell hardness number is 228. If heated to 735 degrees—only ten degrees higher—and quenched, it will bend only 1.5 degrees, and the hardness number is increased to 512. If carried five degrees higher, or to 740 degrees, it will not bend at all, and the hardness is 713. The steel has been completely hardened by raising the temperature at which it is quenched only the comparatively small amount of fifteen degrees from 725 degrees centigrade. This is a range of twenty-seven degrees Fahrenheit, and is less than that of an ordinary spring day. Obviously, to control this action it is necessary to have accurate means of measuring high temperatures, and the pyrometer used should be an indicating one as well as one for measuring; that is to say, it should give instantaneous readings.

Of the different pyrometers to-day available for this purpose, the best known are electrical—the resistance pyrometer, the thermoelectric pyrometer and the optical pyrometer, which is really a miniature incandescent lamp. All three of these instruments give instantaneous readings of temperature, though the accuracy depends, of course, upon the care with which they have been constructed and calibrated. It seems evident that these instruments are destined to play an important part in the valuable researches now being carried on in metallurgy and also in the practice of the art itself. Not a little of the success attained by them already depends upon the ingenuity and skill and the vast amount of scientific research which has been carried on by the makers of electrical instruments in their endeavors to meet the demand for accurate and convenient electrical instruments. To the electrical engineer, more than any other, is due the remarkable development in methods of what may be called commercial measurement which has occurred during the past ten years.

The investigations in metallurgy, according to Mr. Hadfield, are not all being carried on at high temperatures. Those which take place at very low temperatures are equally as important, particularly from a scientific standpoint. For instance, a nickel steel containing twenty per cent nickel is almost non-magnetic at ordinary temperatures. It has a tenacity of forty tons per square inch. Upon being immersed in liquid air it becomes strongly magnetic, and its tenacity increases to 157 tons. This steel, after returning to ordinary temperatures, retains a tenacity of no less than 115 tons. Such a remarkable result, brought about simply by carrying the temperature very low and allowing it to return, is of great scientific interest, for it has an important bearing upon our ideas of physical structure and of magnetism.

The lecturer also called attention to the ignorance of the behavior of the elements at the temperatures supposed to exist in the sun. These, of course, we can not hope to reach, but we can go part way there by means of the electric furnace; and, no doubt, researches in this direction will yield very valuable results. Their success, of course, depends, to a large degree, on the determination of temperature, and it is here that the electrical pyrometers will again be of great value.

ELECTRICAL RESONANCE.

Electrical resonance has always been a puzzling phenomenon to the student and to the engineer. It is a surprising thing to find that between certain points in a circuit that the voltage, as measured by ordinary instruments, may be considerably higher than that produced in the generator; or, in other cases, that the current flowing will be larger than the current flowing from the dynamo. These facts, coupled with the analytical method of explaining resonance which is almost always employed, are the reasons, no doubt, for the mystery surrounding the subject. If the matter were taken up properly, or if the preparation in mathematics given to the engineering student were always sufficient to enable him to use this tool understandingly, the mystery would disappear. No one has any difficulty in understanding how a heavy swing may be set swinging through a wide path by properly timed light pushes, and it does not require a great intellect to comprehend that the swing itself is doing but little work, although it represents a good deal of stored-up energy. This, in a way, is all that resonance means. The swinger times his impulses to the period of the swing. When a similar agreement obtains in other systems the effect is the same. A small force is able to set up a large vibration. It is the old story of the fiddler who fiddled down the bridge.

For these reasons the résumé of electrical resonance which is concluded in this issue is timely and valuable. The author, Mr. F. F. Fowle, does not wrap the subject up in any mystery, and although he uses complex quantities, this is really a method of simplification. The symbol $-j$ in the formula merely indicates a direction. The equations employed in this branch of mathematics show the angular relation between the terms as well as their relative values. Instead of squaring and adding together and then extracting the square root of the two terms of the equation representing the resistance and inductance, we simply write these two out and indicate by the symbol that they are ninety degrees apart.

In addition to his excellent treatment of the subject, Mr. Fowle points out the dangers which resonance may give rise to, and, on the other hand, when it really may be beneficial.

THE ELECTRIC MOTOR FOR MARINE PROPULSION.

The electric motor has proved its utility as a driving mechanism in so many directions that it is not surprising to find it proposed seriously for use in propelling ships. Our esteemed contemporary, the *American Shipbuilder,* in its issue of April 21, calls attention to a system devised by Mr. R. T. Walker, in which the electric motor is utilized in order to make available certain features which it possesses and which are not possessed by the steam engine. The system, in brief, consists in using motors to drive the ship's propellers, the power for the motors being supplied from dynamos driven by steam turbines.

One of the great difficulties in adapting the steam turbine to marine propulsion lies in the fact that the turbine is naturally a high-speed motor. To reduce its speed, and not lose greatly in efficiency, makes it necessary that the machine be large and expensive; yet this must be done if the most effective propeller speed is to be maintained. It is not practicable to increase propeller speeds to any extent, and the present steam turbine ship equipments have been possible only through a compromise which brings the speeds of both the turbines and the propellers near to the limits. The steam turbine also has another disadvantage, since it is not easy to vary its speed efficiently; and the important feature of reversing causes additional complications.

The advantages claimed for the electric drive are the ability to place the generating machinery where it is most convenient, without respect to the location of the propellers; long tail shafts are done away with, and both the turbines and the propellers can be run at the speeds most suitable. The proposed system further solves the question of efficient speed control and ease of reversing. Two or more motors may be employed, driving as many propellers, and by the use of the series parallel control or any of the other well-known means of varying the speed, it becomes possible to sail efficiently at any desired rate.

Against the system may be urged the disadvantage that it calls for three machines instead of one, for besides the turbine there must be a generator and a motor, each, of course, having an output equal to that of the prime mover. However, this seems to be the only objection, and the cost of the additional equipment would certainly be somewhat offset by the elimination of the tail shaft and by a reduction in the weight of the turbine. Just how much this would amount to we are not enough familiar with marine practice to say, but it would probably be considerable. It seems likely, however, that the gain accomplished in the other ways mentioned would be of great value. The ability to place the boilers and engines where they least interfere with the use of the vessel as a cargo carrier would be an important feature, and the advantages of the electric drive have been so thoroughly demonstrated in other applications that it is natural to expect that they will be realized, partially, at least, in this new work. It would be very interesting to have the problem worked out in more detail by some one familiar with the requisites of marine work. A feature of the new system which it seems worth calling attention to would be the ability to place the control of the propellers directly in the hands of the pilot. The engineer would take care of the machinery in his engine room, while the officer in charge of the vessel could easily stop, start, reverse his vessel or vary the speed with a simple movement of a lever. He would thus have as absolute control over the motive power of his vessel as he now has over the steering gear.

DIRECTED WIRELESS TELEGRAPHY.

In a paper read recently by Mr. William Marconi before the Royal Institution, London, a new system of directing the electric waves used in wireless telegraphy was described. Mr. Marconi's paper will be found on another page of this issue. In brief, the system consists simply in stretching the aerial in a horizontal direction instead of erecting it vertically. Mr. Marconi has found that with a length of only two or three hundred metres stretched a few feet above the ground, or even laid upon the ground itself, that waves are sent out which have a considerably greater intensity in the vertical plane through the wire than in any other direction. In some cases signals could be sent in this way in the plane of the wire a distance two or three times greater than they could be detected in the plane at right angles to it. The area through which signals of equal intensity are transmitted in this way seems to be ellipsoidal in shape, with a second, but smaller, ellipse intersecting the larger one in the plane of the wire, but extending in the opposite direction. Such a wave shape does not give a very narrow angle of control, at least so far as the experiments described show; but it should be remembered that as yet only a beginning has been made, and there is no doubt that conditions for improving the system will be devised. But even so far as the work has gone, important progress seems to have been made.

A distinguishing feature of the new method is its simplicity. So far as has been explained, all that is necessary is to carry the wire horizontally, which alone is an advantage over the older method of supporting it vertically. There does not seem to be any need for a system of delicately adjusted oscillating circuits. In the application it would be necessary to lay out a number of horizontal aerials in the directions through which the messages are to be sent, but this, of course, is a very little matter.

The same system of aerials has been found—as might be expected—advantageous at the receiving station, and thus the latter is given some measure of control over the signals which it will accept. The ability to do this might, in some cases, be of very great advantage, such, for example, as when a vessel in distress were calling for help and at the same time some inland station were sending an unimportant message. Further, this system at the receiving station enables it to determine fairly closely the direction in which the signals are coming, a feature which will probably prove of considerable advantage in communicating with ships.

Further developments in this method of transmission will be awaited with considerable interest. The work which has already been done promises important improvements which will, it is to be hoped, go a long way toward solving the many problems which to-day operate against the more general use of this means of transmitting signals.

THE TWENTY-THIRD ANNUAL CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

MILWAUKEE, WIS., MAY 28 TO JUNE 1.

The twenty-third annual convention of the American Institute of Electrical Engineers will be held at Milwaukee, Wis., May 28 to June 1. The Institute headquarters during the convention will be at the Hotel Pfister. The convention session will be held in the Public Service Building, Sycamore street, between Second and Third streets.

The following programme has been announced:

MONDAY, MAY 28.

Address of welcome.

Address—President Schuyler Skaats Wheeler.

"Repulsion Induction Motor," by Maurice Milch, Schenectady, N. Y.

"Comparison of Two and Three-Phase Motors," by Bradley McCormick, Cincinnati, Ohio.

"Direct-Current Motor Design as Influenced by the Interpole," by Charles H. Bedell, Electro Dynamic Company, Bayonne, N. J.

TUESDAY, MAY 29.

"Experiences with Lightning and Static Strains on 33,000-Volt Transmission Systems," by Farley Osgood, associate, New Milford, Ct.

"Cell Type Lightning Arrester," by E. E. F. Creighton, Union University, Schenectady, N. Y.

"Protective Apparatus for Lightning and Static Strains," by H. C. Wirt, Schenectady, N. Y.

"Standardization Rules." The proposed revision of the existing standardization rules will be reported for discussion by the committee on standardization.

"Short-Circuit and Ground Currents in Alternating-Current Systems," by Chas. P. Steinmetz, Schenectady, N. Y.

"The Self-Synchronizing of Alternators," by Morgan Brooks, University of Illinois, Urbana, Ill.

WEDNESDAY, MAY 30.

"Magnetic Properties of Electrolytic Iron," by Chas. F. Burgess, University of Wisconsin, Madison, Wis., and A. Hoyt Taylor, University of Wisconsin, Madison, Wis.

"Measurement of Temperature by Electrical Means," by Edwin F. Northrup, Philadelphia, Pa.

"The Educational Value of an Electric Test Car," by Thomas M. Gardner, University of Illinois, Urbana, Ill.

"The Art of Inventing," by Edwin J. Prindle, New York.

"Shunt and Compound-Wound Converters for Railway Work," by W. L. Waters, Milwaukee, Wis.

THURSDAY, MAY 31.

"Electrical Connections for Power-Houses," by David B. Rushmore, Schenectady, N. Y.

"Economies Derivable from the Use of Relatively Small Water Powers of Low Head in the Middle West," by Dugald C. Jackson, University of Wisconsin, Madison, Wis.

"Oscillations and Surges against Ground in Alternating-Current Systems," by Chas. P. Steinmetz, Schenectady, N. Y.

"Some Fundamental Characteristics of Mercury Vapor Apparatus," by Percy H. Thomas, New York.

"Safety Devices for Steam Engines, Turbines and Motors," by Charles M. Heminway, New York.

"Some Notes on the Lighting of Churches," by Edwin R. Weeks, Kansas City, Mo.

The Convention of the National-Interstate Telephone Association.

The annual convention of the National-Interstate Telephone Association will be held at the Auditorium Hotel, Chicago, Ill., June 26, 27 and 28. The convention will be called to order on June 26, at 2 P. M., and Mayor Dunne will deliver the address of welcome. An interesting programme has been arranged and important matters will be presented in carefully prepared papers, followed by practical talks by men who have taken a leading part in the development of independent telephony.

An informal banquet will be held in the Auditorium Hotel at 8.30 P. M., June 27. Colonel J. D. Powers, Louisville, Ky., will preside as toastmaster.

With a view of showing the substantial character of the independent movement and the general prosperity of the companies comprising it, an exhibit of photographs of independent plants has been arranged. To stimulate interest in this there will be awarded first, second and third prizes of $15, $10 and $5 respectively, for the best photograph submitted.

The manufacturers and supply dealers are cooperating with the association, and have arranged an exhibit of the latest devices in telephone equipment and supplies.

Reduced rates, under the certificate plan, have been secured on all railroads. Full first-rate tickets through to Chicago must be purchased not earlier than June 21, not later than June 27. A standard form of certificate, properly filled out and signed by the ticket agent, must be secured at the station where the ticket is purchased. Upon arriving in Chicago the tickets should be deposited with J. A. Harney, assistant secretary of the association, for his endorsement.

Electric Smelting of Iron and Steel.

During a lecture delivered by Mr. R. E. Hadfield before the Institution of Civil Engineers, in London, England, the speaker touched briefly, and rather unfavorably, upon the electrothermic smelting of iron and steel. He believes that no great revolution will be made in this way, at least for some time to come, and any developments which take place will come slowly. His remarks are as follows:

There are many unsolved problems to be worked out in connection with the production of steel. The Bessemer and Siemens-Martin processes have been carried to a great refinement, and the material produced by them, as regards quality, holds a high place in engineering construction, while the rapidity of production and low cost they have made possible are economic advantages of a high order. Beyond improvements in detail, none the less important because they are small, these processes remain in principle much as they were originally. It will probably be a long time before they are supplanted.

There are those who look forward to an electrical method of producing iron and steel. If any practical system of this nature for converting iron ore into pig iron or steel could be introduced, using the stored-up powers of Nature instead of burning carbonaceous fuel, the revolution in practice would be great. Probably over 100,000,000 tons of coal, equal to about one-seventh of the world's total output, are used annually in the smelting of iron, to say nothing of the further large quantities employed in the subsequent working of iron and steel into more finished form. Where water power and suitable iron ore can be found together, then, no doubt, satisfactory electrical smelting practice will be developed, but this can only come slowly.

Pioneer work is being done in Sweden, France, and Canada, in electrical smelting for the production of steel, but unless water power can be obtained at economical rates it would seem that the application of this system must remain very limited; that other sources of power should be used at present appears out of the question from an economical point of view. Moreover, the electric furnace does not purify steel more than other furnaces not specially adapted to that purpose. Bad steel can

be produced by it as easily as by the ordinary processes. Some of us know how often the old type of crucible steel smelting, so largely practiced in Sheffield, has been threatened with extermination, but more material is now produced in this way than ever before. The electrical system has in this older method, notwithstanding its extraordinary wastefulness, a competitor that will not soon be annihilated. There is no magic in the electrical method as it would almost seem some would have us believe. Steel made by it shows similar analysis, and has the same physical qualities as that produced in other ways.

An important question in connection with electric furnaces is, whether they can ensure uniformity of temperature. It is well known that they are apt to produce steel which is much colder at the top of the molten bath than underneath; this is, of course, objectionable. Of the many failures with electric furnaces we hear little; it would be interesting to know more about them. I say this in no disparagement of a "young" process, but to prevent the uninitiated being dazzled by the mere term "electric."

It is stated that the efficiency of the electric furnace is already comparatively high, say, fifty per cent, but under present conditions it would still be more expensive to develop heat at any temperature within the range of a coal-fired furnace by electricity than by coal; that is, if electricity has to be generated by steam power, even with plant of the highest efficiency.

The electric furnace has a range of temperature of about twice that of the ordinary steel furnace, so that it will extend up to about 3,000 degrees centigrade. Reactions which take place within certain limits of temperature as now practiced may be reversed at the higher range made available by the electric furnace. We can not foresee what will be the behavior of metals at temperatures above the limit of our present ordinary furnaces, that is, above about 1,500 degrees centigrade.

Accident to Professor John Perry.

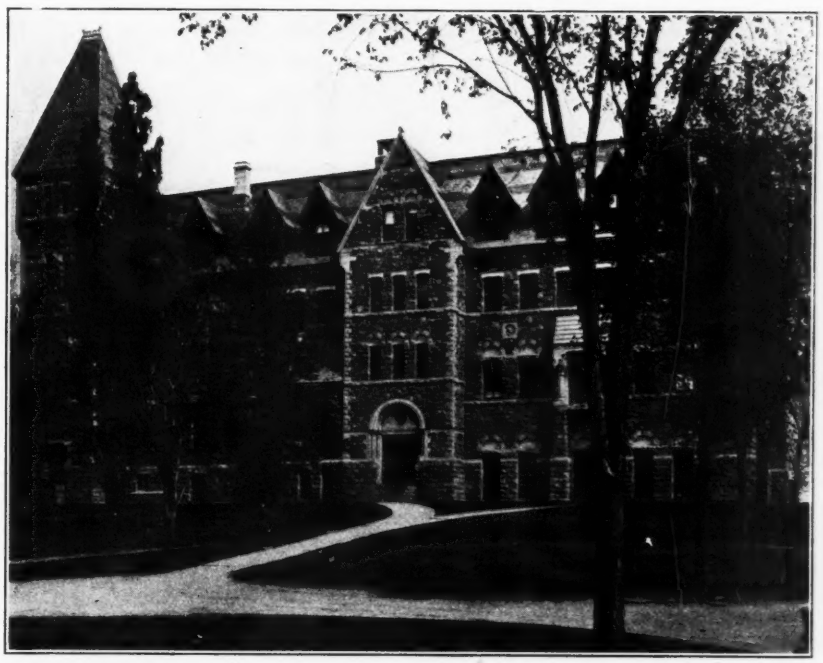
Professor John Perry, of the Royal College of Science, London, met with an unfortunate accident on April 13, when he was thrown from Col. R. E. B. Crompton's automobile, through a collision with a street car. Professor Perry was thrown out, severely bruising his face and badly injuring his arm. He is now doing well, but it is feared that he will never fully recover the use of the injured arm. Col. Crompton escaped without injury.

A New Standard Photometric Oil Lamp.

Dr. A. H. Elliott, after about a year's experience, has developed a simple standard photometric oil lamp which has valuable features, particularly for use in measuring the intensity of gas flames. He adopted a flat wick, one and one-half inches wide, held in an ordinary burner, and supplied with kerosene oil by the well-known student lamp-feed system. He has found that, for practical purposes, this lamp has many advantages. It is constant over a considerable period of time; it is easily arranged and adjusted; several persons can obtain the same results without difficulty, and the standard is not difficult to reproduce. The intensity of the flame is little affected by the character of the wick and by slight variations in the quality of the oil. In use, the wick is trimmed when dry so as to be one inch wide at the top, the corners being cut off diagonally at an angle of about sixty degrees. A flame screen is placed between the flame and the photometer, which has an opening one and one-half inches wide and seven-eighths of an inch high. The flame is adjusted until this screen just cuts off the top and side edges and a part of the blue zone shows through the opening. It is best, in preparing the standard, to select a wick which has been found to give good results, and then to buy a gross of them at a time, as in this way a uniform quality will be obtained. The chimney employed is Macbeth's No. 40 pearl glass. The wick may be used for about a week by brushing off carefully the charred top, but it is best not to use them too long, as the capillarity decreases with use. Some tests are given to show the reliability of this secondary standard. When used on different days, by different observers, the candle-power does not vary more than a few per cent, and averages a little over ten candles. A number of lamps constructed in this way, when compared, gave concordant results. It is important, in using the lamp, to trim the wick carefully.—*Progressive Age, New York.*

More Room for Electrical Engineering Department at Cornell.

The trustees of Cornell University have recently assigned to the Department of Electrical Engineering of Sibley College the major portion of Franklin Hall, now occupied by the Department of Physics. The latter department is now moving into commodious quarters in the new Rockefeller Hall of Physics just completed. The Electrical Engineering Department will thus be supplied with new quarters for conducting various lines of work. The electrical engineering laboratory will continue to occupy a part of the main building of Sibley College, as Franklin Hall does not contain sufficient floor space to accommodate all of the apparatus.



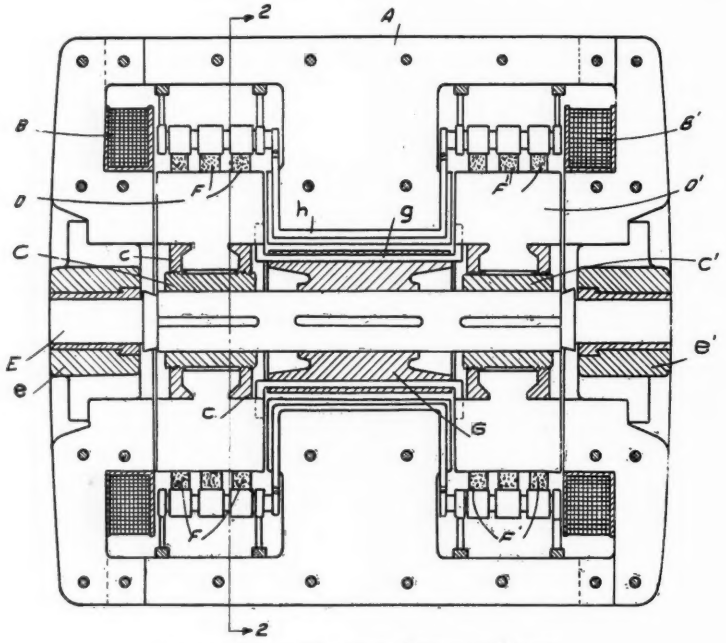
FRANKLIN HALL, CORNELL UNIVERSITY.

Franklin Hall, after the remodeling which will be necessary this summer, will contain large designing and lecture rooms, a number of smaller recitation rooms and offices, and the telephone and railway laboratories. It is understood that the new arrangement will be only temporary, as the enlargement of the main Sibley College buildings will be an urgent necessity if the present rate of growth continues.

A New Alternator.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

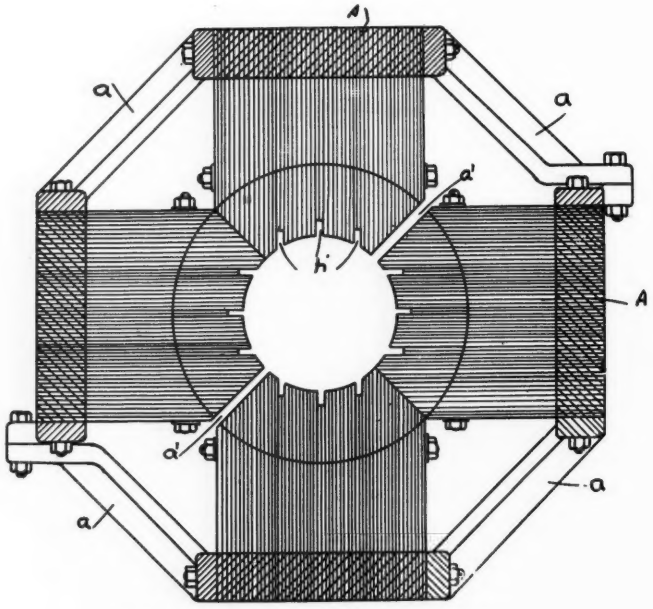
With great interest I have read your editorial comments on "A New Alternator." You quote patent No. 8,569 on alternating



ARRANGEMENT OF PARTS, UNIPOLAR MOTOR.

unipolar current dynamos of the British Thomson-Houston Company, which was granted to the undersigned. The present state of the art, with regard to collection of currents, which fundamentally determines the efficiency and weight of the unipolar dynamo, limits its field. In general the multipolar alternating-current motor and generator have all the advantages at present, but in case of very high speeds and for very low and very high cycles the new dynamo may find a field, because the magnitude of the electromotive force induced in the armature conductors is, in a general way, dependent upon the flux and speed, and not on the cycles impressed.

The sketch, which serves as an illustration for the patent, shows an arrangement



ARRANGEMENT OF PARTS, UNIPOLAR MOTOR.

especially suitable for low-frequency generators. For other purposes any of the well-known forms of unipolar structures may be used, provided they are laminated in the proper way. The armature reactions are not a very serious point. On the principles discussed before the American Institute of Electrical Engineers last year unipolar generators have been designed for direct current, which at four times normal current did not show a prohibitive drop in voltage. There leads were, of course, momentary loads. It is possible to use the armature currents for excitation as discussed before with regard to direct-current unipolar dynamos by giving a circumferential displacement to the leads that connect the armature conductors to the collector rings, or the commutator segments. It is also possible to do away with separate excitation winding by giving the brushes a circumferential displacement on the stationary conductors. In both cases the leads form part of turns surrounding the flux. Instead of the commutator collector rings can be used if their electrical continuity is interrupted preferably at two or more points. A complete ring would enclose the alternating flux, thereby acting as a short-circuited secondary coil with the exciting winding as primary.

J. E. NOEGGERATH.

Schenectady, N. Y., May 19.

Damage to California Universities from the Earthquake.

It is reported that the damage to the scientific laboratories and collections of Leland E. Standford, Junior, University, is much less than indicated by the first reports. The buildings containing the departments of physiology, botany, zoology, entomology are not injured, and almost no damage was done to the apparatus and collections. The chemical building was slightly damaged, and the loss in apparatus and supplies amounts to a few hundred dollars. The geological and metallurgical laboratories were also unhurt, though the large new geological building was seriously injured. The building in which the department of physics and the department of psychology were placed lost part of one wall, but the equipment was not much injured. The laboratories and shops of the engineering departments were injured, though not very badly. The greatest damage was done to the Memorial Arch, the church, the museum, and the new library and gymnasium buildings. Work will begin at this university in the fall.

The University of California suffered most severely from the loss of income. This, it is said, will amount to $60,000 yearly, and there is a further loss of about $50,000 yearly due to a reduction in the value of assessable property in the state. The buildings at Berkeley suffered very little, but academic work has been suspended for the present on account of the relief work, in which the greater part of the faculty is engaged.

A RESUME OF ELECTRICAL RESONANCE.

(Concluded.)

BY FRANK F. FOWLE, S.B.

CONSONANCE.

Consonance is the term applied to the phenomena of resonance which occurs in a given circuit, due to the properties of an adjacent circuit which are communicated to the given circuit by mutual inductance. Resonance in the primary circuit of a transformer may occur when a condenser is present in the primary or the secondary and exists when the effective reactance and the effective condensance in the primary circuit are equal. If the condenser is in the secondary the oscillations or surgings of energy between the electric and the magnetic fields, that is, between the condensance and the reactance, take place through the mutual inductance constituted by the magnetic field of the transformer. The theory of the subject is considerably more complex than the theory of resonance in simple circuits. A primary circuit of a transformer which is resonant, due to a condenser in the primary circuit, will cease to be resonant when the load on the secondary is changed. As the non-inductive load on the secondary increases, the apparent resistance of the primary increases and the apparent inductance diminishes. When there is a condenser in the secondary consonance occurs with particular values of the secondary circuit, and therefore at a particular secondary load.

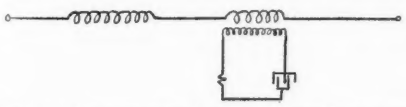


FIG. 7.—CIRCUIT WITH TRANSFORMER SUPPLIED WITH CONDENSER IN ITS SECONDARY.

The theory of consonance is treated in Bedell's "The Principles of the Transformer," page 227, and reference is there made to other writings on the subject.[1] A transformer non-inductively loaded is magnetized by two magnetomotive forces which are nearly opposite in phase, at full load. If the secondary load is inductive the regulation is impaired, and magnetic leakage, due to the difference in phase between the two magnetomotive forces, is increased. A condenser in the secondary circuit may be proportioned to overcome the effects of secondary inductance or of magnetic leakage.

The presence of a condenser in the secondary may, moreover, apparently increase the ratio of transformation because of the neutralization of the internal reactance by the external condensance; and if the secondary current is in advance of the electromotive force, the reactive drop may so combine with the generated secondary electromotive force that the terminal electromotive force exceeds the generated electromotive force, although this is not a resonant condition. With a power-factor sensibly unity, or within a few per cent of it, the effect of a secondary condenser is disadvantageous because of the increased ratio of transformation and of the generator reactions with a leading current. The latter tends to increase the generator electromotive force and the resultant regulation is poor.

A practical application of consonance occurs in the use of condensance in commercial phasing devices. When the voltage is low and the frequency moderate the necessary capacity is often so large as to be very cumbersome and expensive. It is then economy to insert a step-up transformer in the circuit, with a condenser connected to its secondary. The greater inductance and the increased voltage permit the use of a much smaller and less expensive condenser. Such a circuit is shown in Fig. 7.

It may be mentioned here that condensers constructed with mica insulation or its equivalent are the only sort whose capacity remains constant and which are suitable for use with high potentials. Paraffine condensers are unreliable and of low dielectric strength. A capacity of one microfarad is a commercial size, and for voltages less than 1,000 may be contained in a volume less than one-tenth of a cubic foot. Air condensers are usually of very low capacity—a very small part of a microfarad.

EFFECT OF FREQUENCY.

Frequency and its variation is one of the fundamental factors in resonance. At commercial frequencies used in the distribution of energy resonance may occur to a partial degree with iron inductances and will upset regulation, if not give rise to dangerous currents and potentials. At frequencies of several thousand cycles per second, which occur in telephone circuits, resonance can practically be obtained only with inductances having no iron. The disturbing and distorting effects due to hysteresis and eddy currents increase rapidly with the frequency. If the admittance of a circuit, resonant at a given frequency, be plotted as a function of the frequency, there will be a decided peak in the curve as the resonant condition is approached and passed beyond; exact resonance will be shown by the tip or uppermost point of the peak,—plotting admittance or current as ordinates and frequency as abscissæ. The characteristics of the peak depend on a number of conditions. By examining Fig. 3 it will be seen that the peak will be most pronounced when x_c and x_l are large compared with r, and the exact condition of resonance is critically dependent on the frequency. Fig. 8 shows the effect of the variation of frequency in a circuit so proportioned that the peak is pronounced.

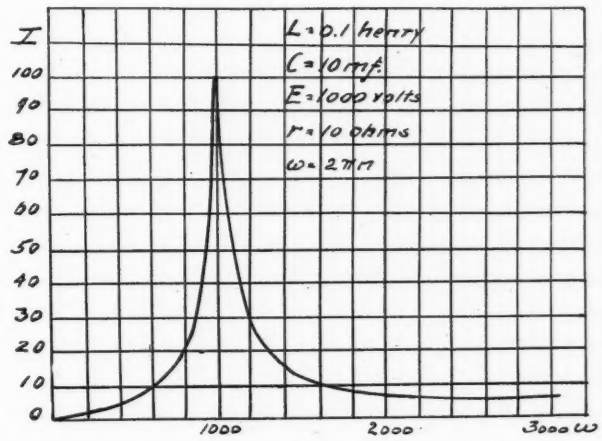


FIG. 8.—EFFECT OF VARIATION OF FREQUENCY IN A CIRCUIT SO PROPORTIONED THAT THE PEAK IS PRONOUNCED.

The effect of increasing r from 10 ohms to 100 ohms will be to reduce the height of the peak to ten amperes and to render it far less pronounced.

The effect of the variation of frequency in a circuit, as shown in Fig. 4, is given in Fig. 9. The current at resonance is a minimum in the external circuit. The values of x_2 are all computed from expression (13), using the positive sign only.

Increasing r_1 and r_2 will render the depression of the curve in Fig. 9 less pro-

[1] *Electrical World*, February 5, 1895, Pupin on "Electrical Consonance." March 2, 1895, Steinmetz on the same subject.
The *Physical Review*, vol. ii, p. 442; Bedell and Crehore on "Resonance in Transformer Circuits."

nounced and will change the frequency at which the circuit is resonant. If $r_1 = r_2$ and $\frac{L}{C} = r_1^2$, the circuit will be resonant at any frequency.

If Figs. 8 and 9 were plotted for constant current instead of constant potential, in terms of the frequency (or 2π times the frequency) and the potential, the curve of Fig. 8 would be converted into a depression instead of a peak, and vice versa in Fig. 9.

There is an infinite variety of circuits whose resonant properties may be studied, but the distribution of current and potential in a given branch follows the above laws, and by means of Kirchhoff's laws as applied to general networks, the fundamental equations of any problem may be written down.

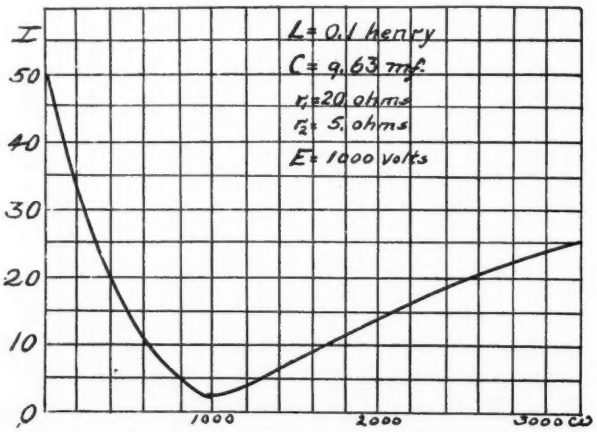


FIG. 9.—EFFECT OF VARIATION OF FREQUENCY IN A BRANCH CIRCUIT IN WHICH RESONANCE IS POSSIBLE.

SURGING.

Resonance may occur in transmission lines, with concentrated resistance, inductance and capacity at each end of the line and distributed resistance, inductance and capacity in the line. The investigation of this phenomena belongs in the general theory of the action of such lines,[1] and is an extended subject. Line resonance very rarely occurs at the frequencies employed in power transmission, because the total line condensance usually far exceeds in magnitude the line reactance. With distorted waves the phenomenon may occur at the frequency of one of the higher harmonics which is a component of the resultant distorted wave. This is not likely to occur with modern machinery because of the adoption of distributed windings, which tends toward the production of more nearly sinusoidal waves. There is a class of phenomena whose occurrence is not rare and whose results are disastrous; when the load, and consequently the circuit arrangement, is suddenly changed, oscillations of very high potential and frequency may take place. The subject has been investigated by Steinmetz,[1] and his writings should be consulted.

He concludes that the most dangerous conditions obtain in rupturing a short-circuit and in opening the transmission line under load.

The occurrence of resonance in distribution lines or transmission lines, if severe, is dangerous to life and to apparatus; if not severe, but of moderate magnitude, is quite certain to result in poor regulation. The apparent ratio of transformation in transformers is increased and the armature reaction in alternators may be such that at a load less (or greater) than that which produces resonance the generated electromotive force is diminished, and at a load greater (or less) than that which produces resonance the generated electromotive force is increased. The latter effect arises from the fact that an alternator at constant speed and excitation, on non-inductive load, will give a lower terminal electromotive force if the load is changed so that the current is lagging and a greater terminal electromotive force if the current is leading—with respect to the generated electromotive force. Resonance at the frequency of one of the higher harmonics in a distorted wave will increase the iron and copper losses, reduce the efficiency and increase the distortion; in synchronous and rotary field apparatus additional complications will occur.

OSCILLATIONS OF HIGH FREQUENCY.

The application of resonance in the production of oscillations or alternating currents of very high frequency has practical value in wireless telegraphy and telephony. These currents are produced by recurringly energizing, and allowing to deenergize naturally, circuits whose natural or resonant frequency is very great. Equation (2) may be put in the form

$$n = \frac{1}{2\pi\sqrt{LC}}$$

and n may be increased indefinitely by decreasing the denominator indefinitely. The ordinary coil for producing high-potential discharges of a disruptive nature consists of a tuned secondary circuit, whose capacity is obtained by means of the condenser composed of the oppositely charged knobs (between which the discharge takes place) and a primary circuit intermittently energized from a battery by means of an interrupter. The application of high-frequency oscillations in wireless telegraphy is an extended subject, and for the theory and the history of it the various writings on the matter should be consulted.[1]

A High-Tension, Continuous-Current Railway at Cologne.

A high-tension, continuous-current railway system has been constructed between Cologne and Bonn, Germany. The road is about eighteen miles long. Outside of the cities the construction is simply that of steam railroads; within the towns the local tramway tracks are used. The power-house is placed at Wesseling, near the middle of the line. It is equipped with two 330-kilowatt, 990-volt, direct-connected generators. The feeding system has been divided into three sections. The central section is fed directly from the power-house and the two outer sections are fed through boosters. There is a storage battery at each of the two feeding points of the outer sections. These batteries float across the line. The wires are suspended by the catenary system. There are two conductors for each track, held apart by spacers and suspended from a single steel messenger cable. The trolley wires are insulated from the messenger wire by porcelain insulators, and the same material is employed for insulating the steel cable from the poles.

The cars are equipped with two 900-volt motors with single reduction gearing. The motors are rated at 130 horse-power, each having four poles, and are fitted with commutating poles. The multiple unit system of control is employed, enabling two motor cars to be coupled together. Each motor car is capable of making a speed of over forty miles an hour when drawing a single trailer. Current for the control system is supplied by a small storage battery carried on the car. Each car is fitted with two bow collectors.

[1] Alternating current phenomena, 3d edition, by C. P. Steinmetz.

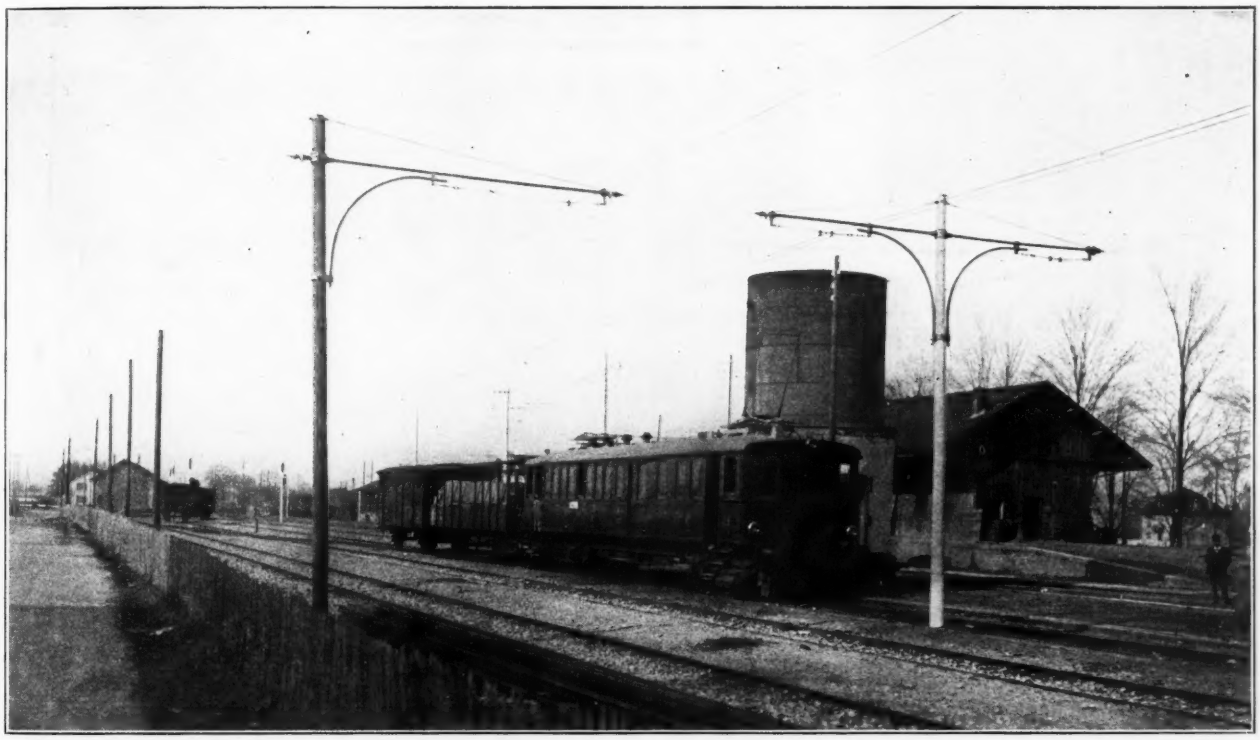
[1] Theoretical investigation of some oscillations of extremely high potential in alternating high potential transmissions; a paper before the American Institute of Electrical Engineers, August 22, 1901, by Charles Proteus Steinmetz.

[1] Wireless telegraphy; its origins, development inventions and apparatus; by Charles Henry Sewall.

An Interesting Swiss Electric Road.

By C. L. Durand.

AMONG the principal electric railroads which are now operating in Switzerland is the Fribourg-Morat-Anet line, lying in the neighborhood of lake Neuchatel. It connects the important town of Fribourg with a number of localities in the region and at present it has a good traffic, both in the way of passengers and freight. The direct-current system of running is used in this case, and the trains are made up of motor cars and trailers. The current is taken by a third rail on some parts of the line, while on other sections an overhead trolley is used.



Motor Car and Trailer Freight Train—Fribourg-Morat-Anet Single-Phase Line.

The portion of the electric road which runs between Fribourg and Morat serves to connect two sections of the main railroad line which pass by each of these stations. The tracks of this section already existed before the time of the electric road, and it was used for running steam trains between these two points. This section was operated by the Jura-Simplon Railroad Company. At present it is electrified for the operation of the trains and at the same time a new section has been added, making an extension of the line from Morat to Anet and connecting it with the Berne-Neuchatel trunk line. The section between Fribourg and Morat is about fifteen miles in length and the second part of the line seven miles, making a total of twenty-two miles for the whole road.

Current is supplied for the system from hydraulic plants situated at some distance from the road. These stations furnish three-phase current, which is brought on an overhead line. The main voltage of 8,000 is converted to 750 volts direct current by two substations located on the railroad line. The motors on the cars are operated on the 750-volt system, as designed by the Oerlikon Company, who furnished all the outfit for the trains and the substations. The trains of the road are made up of a motor car and a certain number of trailers. Both passenger and freight trains are run over the line.

One of the illustrations shows the general appearance of the trains on the Fribourg-Morat-Anet line. The motor car having the cabin in the front end and the rest of the space for the passengers takes a certain number of trailers. These may be passenger cars of a shorter type, or, as here shown, freight trains of the usual railroad type. The passenger trailers are of the three-axle or two-axled type, the latter form being a lighter car. In general, the total weight of the train is allowed to reach seventy tons, and the trains are made up with passenger or freight cars accordingly.

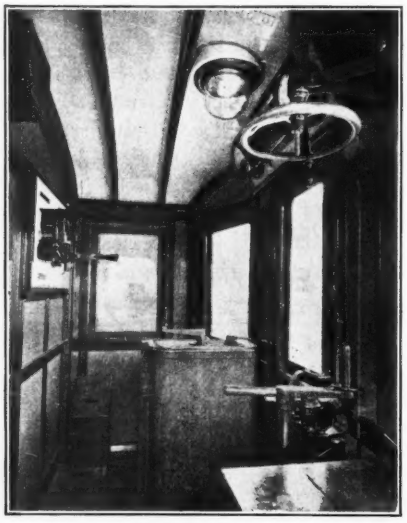
The electric outfit of the motor car consists of Oerlikon motors, of which two are mounted on each car, one upon each bogie. These motors are designed to furnish about 150-horse-power maximum output, and are wound for 750 volts. They are built on the lines of the all-enclosed, four-pole, drum-armature motor. The field poles are formed of laminated iron. Upon them are placed coils made up of sixty turns of a seven-millimetre wire. A resistance of 0.07 ohms is given with the four coils connected in series.

The armature of the motor measures twelve inches long by twenty-two inches diameter and has a winding laid in slots in the usual way. The periphery contains forty-nine slots, each of which receives twelve conductors. A conductor is formed in this case of two wires varying from 3.4 to 3.8 millimetres and coupled in parallel. The resistance of the armature is 0.12 ohms.

The motors have been designed so as to stand a considerable overload without undue heating, and it is found that a double

load can be thrown on the motors for a short time. With such a load the commutator does not show any bad sparking. On the usual load the commutator does not heat up more than forty degrees centigrade above air and is quite free from sparking.

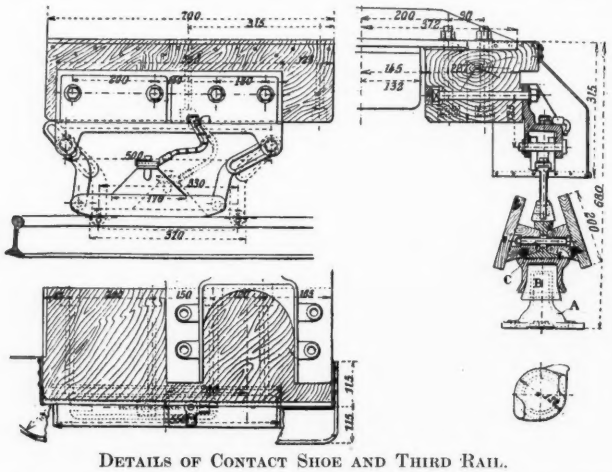
One illustration shows a view taken in the inside of the motorman's cabin. In



Interior of Motorman's Cab—Fribourg-Morat-Anet Single-Phase Line.

the front part is an upright controller of the new Oerlikon design. It works on the same general principles as the usual type of tramway controller, but otherwise the construction had to be modified considerably in order to take care of the heavy current which are to be handled in this case. A magnetic blowout which has a very strong action is provided here. To the left is a marble panel which contains a number of instruments. Among these are an automatic circuit-breaker, a hand switch which allows of breaking the circuit of the third-rail contact shoes, when the overhead trolley is employed, also the main fuses of the motor circuits and the switches for controlling the electric lighting and heating circuits of the motor car and the trailers. Mounted in front of the motorman is a small marble panel which is placed between the window and the ceiling of the car. It contains an ammeter and a voltmeter connected upon the main current so as to aid in carrying out the manœuvers of the car and show the effect of working the controller, especially at starting. The electric outfit is completed by a set of resistances mounted in air-cooling boxes and placed underneath the floor of the car.

Special attention has been given to the mounting of the third rail of the track. This is a rail of the Vignole type, which is much used on the Continent, weighing fifty pounds per yard and laid in sixty-five-foot sections. A specially soft steel is used for this rail so as to give it a high conductivity. The resistance is much lower than for an ordinary steel rail, seeing that it is but 0.12 ohms per yard, while 0.24 ohms is about the figure for the average rail. The sections are connected in the usual way by copper rail bonds of 100 square millimetres section. The method of mounting the rail is shown in the diagram, where A is a cast-iron support resting on separate ties, B an insulating cylinder of ambroïne and C a cast-iron support fitting upon the latter and carrying the third rail. Between C and B is placed a sheet of linoleum of a good thickness,



Details of Contact Shoe and Third Rail.

Fribourg-Morat-Anet Single-Phase Line, Showing Station, Overhead Line and Third Rail.

as this is found to diminish the shocks which the rail may cause upon the insulating piece. Above the third rail is observed the contact shoe and the method of suspending it from the car body. Expansion joints are provided in the third rail every 300 feet or more, leaving a six-inch space between the ends of the rail. The latter are held together in a special form of fish-plate, which is arranged so as to take the contact shoe of the car, so that there will be no break in the current at these points. The ends of the rails are joined by a copper cable.

The contact shoes which are mounted on the cars are of an improved form and constructed of malleable iron, two of these being placed on each side of the car. Pressure on the rail is obtained simply by the weight of the contact shoe. Each of the motor cars is equipped with two trolleys for use upon the overhead part of the line. These trolleys, which will be observed in the engraving, are of the bow pattern and have a well-designed spring base.

As regards the general design of the motor cars, their total length between buffers is about fifty-five feet and the maximum width ten feet. The distance between centres of the bogies is thirty-six feet, with the two axles of the bogie spread eight feet apart. The total weight of the motor car is thirty-six tons when in full running order. Besides the hand brakes the cars are equipped with a set of Westinghouse brakes, having an air pump driven by chain from the motor. An electric braking action is obtained by working the motors as generators upon the starting resistances.

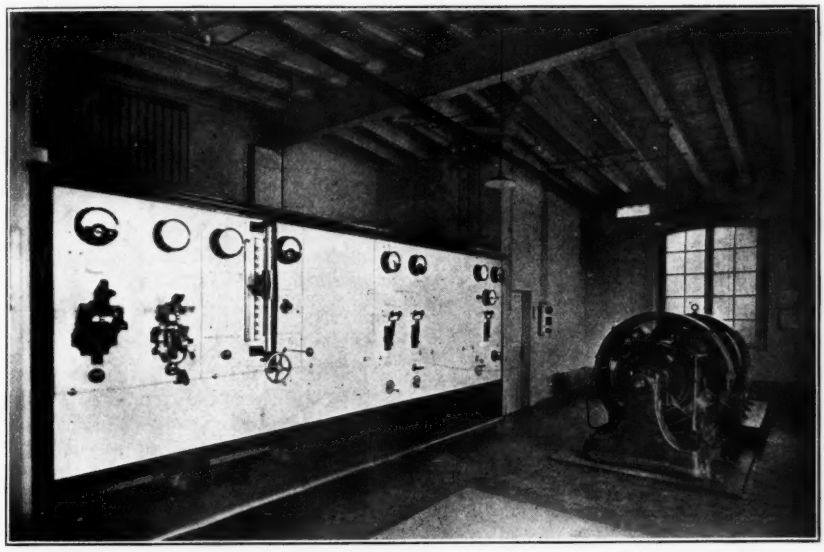
In another illustration is shown the substation of Pensier, lying at the seventh mile point on the line, with the railroad station in the rear. The method of mounting the third rail and also the arrangement of the overhead trolley system will be noticed here.

Current for operating the line is furnished by a distant station and is brought over a high-tension line working at 8,000 volts upon the three-phase system. In

order to convert this current into low tension for the overhead trolley wires and the third rail there have been erected two substations on the railroad line. One of these is placed at Pensier, a railroad station about seven miles from the starting point. The second station at Morat lies at the 12.8 mile point. The traffic on the line at present consists of ten trains of eighty tons weight per day. The time-table has been laid out so that each of the substations will only be required to supply current for a single train at a time and this arrangement prevents the machines in the station from being overloaded. The crossing point of two trains running in the opposite directions occurs at about the middle point of the line, so that even here we find that each substation is only obliged to furnish one-half the total power, or for one train only. To provide for an increase of load upon the substation a large battery of accumulators has been placed in each of the latter, running in parallel with the machine. The battery has a capacity of 100 kilowatts, and is made up of 400 cells having 210 ampere-hours capacity at a one-hour discharge rate. Seeing that the train when going up the heaviest grades of the road only requires 240 horsepower delivered at the wheel, the substation when using the machine and the battery in parallel has enough power to provide for all cases which may occur.

A view taken in one of the substations is shown herewith with the rotary group on the right hand and the marble panel switchboard on the left. The rotary group is made up of a three-phase synchronous motor coupled on the same shaft with a direct-current generator, both machines being of the Oerlikon type. On the other side the three-phase motor is coupled to an exciter which works at thirty volts and 200 amperes. The synchronous motors of the stations are designed to give a normal capacity of 150 kilowatts and are run directly upon the 8,000-volt high-tension line at a speed of 500 revolutions per minute. The direct-current generators are built to deliver 800 volts and have a capacity of 100 kilowatts.

As regards the storage battery which the substation contains, it is arranged in two equal parts, and when under charge from the machine the two halves are connected in parallel. Upon the discharge the two parts are coupled in series. By this method the battery can be charged at a low voltage and the use of a special booster is avoided.



SUBSTATION INTERIOR—FRIBOURG-MORAT-ANET SINGLE-PHASE LINE.

Special Report on Telephones and Telegraphs, 1902.

A report on the telephone and telegraph systems and the municipal electric fire alarm and police patrol systems of the United States has just been published by the Bureau of the Census. The statistics were collected and compiled under the supervision of W. M. Steuart, chief statistician for manufacturers, and the text was prepared by T. C. Martin, New York city, expert special agent.

This is the last of a series of reports on the generation and utilization of electric current for the transmission of power, messages and conversation. Former reports relate to street and electric railways, and central electric light and power plants.

This report presents statistics concerning the physical equipment, service and financial operations of the commercial and mutual telephone and telegraph systems of the country, and the physical equipment of independent rural telephone lines.

The statistics of the telegraph and telephone industries of the United States were first shown in the census of 1880. At that time telegraphy had been growing steadily for nearly forty years and telephony was in the formative stages of development. Since then, however, telephony has progressed to such an extent that it has surpassed telegraphy in physical and financial magnitude.

In 1902 the telephone systems operated more than three-fourths of the wire mileage reported for both telephones and telegraphs, gave employment to seven-tenths of the wage earners, paid more than two-thirds of the wages, received more than two-thirds of the total revenue, and paid more than two-thirds of the total expenses.

TELEPHONES.

The telephone systems are divided into three classes, as follows:

1. Commercial systems, including all systems operated by individuals, firms, or corporations, primarily for revenue.

2. Mutual systems, including all systems operated through a mutual arrangement among persons deriving benefit from the service, primarily for the benefit of the owners, revenue being incidental to the operation of the line.

3. Independent farmer or rural lines, including all lines having no regular exchange or central office.

In 1902 there were 3,157 commercial systems, 994 mutual systems and 4,985 independent rural lines. For the commercial systems the mileage was 4,779,571, and the number of telephones, 2,225,981; for the mutual systems the mileage was 70,915, and the number of telephones, 89,316; and for the independent lines the mileage was 49,965, and the number of telephones, 55,747.

In connection with the commercial and rural systems there were 10,361 public exchanges. The pay stations numbered 80,870, of which 32,477 were automatic.

The number of salaried employés engaged in the telephone service was 14,124, and the average number of wage earners, 64,628. The amount paid in salaries was $9,885,886 and in wages $26,369,735.

THE BELL SYSTEMS.

Although there were only forty-four Bell systems in 1902, they reported about seven-tenths of the wire mileage for all telephone systems, more than one-half of all the telephones and three-fifths of the messages or

talks during the year. They employed over seven-tenths of the wage earners and paid almost four-fifths of the wages.

TELEPHONE CALLS.

The number of messages or talks reported for the year was 5,070,554,553; of these, 4,949,849,709 were local exchange calls and 120,704,844 were long distance and toll calls.

Ohio led in the total number of messages, with 558,707,801; and Illinois was next, with 541,161,932. In long distance and toll traffic Pennsylvania was first, with 20,409,621 messages; and New York was a close second, with 20,367,024. The greatest number of local messages, 547,238,743, was reported for Ohio, and the next largest, 535,744,349, for Illinois.

The report shows that on the average there was one telephone to every thirty-four persons, that each person talked sixty-five times a year, and that each telephone was used 2,190 times.

Generally speaking, a liberal provision of telephonic facilities means a large number of calls or messages per capita and a low number per instrument.

The distribution of telephones, the use of each instrument, and the number of messages per capita do not depend solely upon density of population. Among the other factors are the kind of population, the nature of the prevailing industries, the tariff charged for telephone service, and the assiduity with which the telephone habit has been cultivated by the managers of the companies supplying service.

During the past ten years there has been a very rapid and wide extension of telephone service in the rural districts, but the industry has shown the greatest growth in the states having the largest population, and has reached its highest development in the leading cities.

In 1900 there were 1,157 incorporated urban centres with 4,000 or more inhabitants. Of these, 1,002 were provided in 1902 with telephone systems of some description. San Francisco, with one telephone to nine persons, was the best telephoned city in the United States in 1902; while Cleveland ranked second, with one telephone for every sixteen persons; and Boston was third, with one telephone for every nineteen inhabitants.

The average revenue per telephone amounted to $37.50 and the average per message to 1.7 cents; while the average operating expense was $24.56 per telephone and 1.1 cents per message.

Reports were received for one system in Alaska, one in the Philippines, and seven in Hawaii. For these nine systems there was an aggregate of 5,518 miles of wire, 2,891 telephones and 3,887,925 messages.

TELEPHONES IN FOREIGN COUNTRIES.

The introduction of the telephone in the United States was followed by its adoption almost immediately in all the countries of Europe and more slowly in other parts of the world. But while in the United States the development of the telephone has been left to private enterprise, in Europe the telephone, along with the telegraph, has remained almost exclusively subject to governmental control.

In the report a table is given showing the telephone statistics as of January 1, 1905, for the United States and Europe. The number of telephones for the United States was 3,400,000 and the number for Europe 1,485,784.

TELEGRAPH VERSUS TELEPHONE.

The effect of the telephone in reducing or checking the amount of telegraph business is produced in two ways—by substituting the long-distance telephone call for the telegraph message between two widely separated points, and by obviating to a very large extent the necessity for using the telegraph within city limits.

The rates of the two systems for medium distances do not differ greatly, and for very long distances they are overwhelmingly in favor of the telegraph, if the message be taken as a unit; but if the number of words exchanged be taken into account as well as the time required for getting into communication, the telegraph is at a disadvantage in case of a large amount of traffic.

Frequently the brief message will suffice and the written telegram serves as a record; but where a swift interchange is required, the telephone seems to have thoroughly established its superiority for social matters and for business. The public employs the telegraph at the rate of only a little more than once a year per capita, whereas the number of telephone messages is already sixty-five per capita.

TELEGRAPHS.

The telegraph systems are divided into two general classes—the commercial land telegraph and the ocean cable systems, including all systems organized primarily for the transmission of messages for the general public; and the railway telegraphs, including all wires owned and operated in connection with railway systems.

The commercial telegraph systems of the country owned and operated 1,318,350 miles of wire in 1902. In addition there were 16,677 nautical miles of submarine cable. The twenty-five systems had an investment, or capitalization of stocks and bonds, of $162,946,525; a total revenue of $40,930,038; and total assets of $195,503,775. A sum amounting to $15,039,673 was paid in salaries and wages to 829 salaried employés and 26,798 wage earners.

The railway telegraph systems were reported by 684 companies. They employed 30,336 operators and despatchers, to whom $20,040,730 were paid in wages. The number of messages sent during the year for railroad business only was $201,743,756 and the number of commercial messages was 4,474,593.

GOVERNMENTAL TELEGRAPH AND TELEPHONE SERVICE.

The report contains an interesting chapter on the employment of the telegraph and telephone by the government.

It shows the statistics for the telegraph and telephone service of the signal corps in the United States, in the Philippines and in Alaska, and discusses the use of telegraphy and telephony in the work of the Weather Bureau and the life-saving service.

ELECTRIC FIRE-ALARM SYSTEM.

Electric fire-alarm systems were installed as early as 1852, and by 1902 there were 764 such systems in operation. There are, however, a great many communities which still retain the inadequate method of notifying the people of the occurrence of a fire by the ringing of a bell or by the blowing of a steam whistle, the number of strokes or blasts indicating roughly the location of the fire. The fire-alarm systems were distributed through forty-eight states and territories, although they were found chiefly in the older and more densely populated sections. The largest number, 106, was reported for Massachusetts and the next largest, 70, for New York.

The practice of putting the fire-alarm wires underground has increased rapidly during late years, and more than one-fourth of the 39,635 miles of such wire was underground in 1902. There were 37,832 signaling and annunciating boxes and 1,900 special telephones for use in connection with the fire-alarm service. During the year 1902, 85,070 fire alarms were turned in through these boxes and telephones. Of these alarms, 12,794 were credited to New York; 9,491 to Massachusetts and 9,027 to Illinois.

ELECTRIC POLICE PATROL SYSTEMS.

The utilization of the telegraph as an aid in the detection and suppression of crime, and also in connection with other duties falling to the protectors of the peace, was resorted to at a rather early date by the police departments in various large cities. The combination of the telegraph and telephone as an auxiliary to the police force was first introduced in 1880.

In 1902 the police patrol systems were distributed in thirty-two states and the District of Columbia, most of the systems being located in the states with the greatest number of large cities. Massachusetts is credited with the largest number, twenty-eight; and New York ranked second, with fourteen.

There were, in 1902, 148 police patrol systems, with 26,350 miles of wire. The signaling boxes numbered 9,476; and the telephoning boxes, 1,170. Over these instruments 40,626,505 police calls were received or sent. This gives an average, per box or station, of 3,816 messages during the year, or a daily average of more than ten calls.

The use of the telephone predominated, the number of telephonic messages being 23,393,812, as compared with 17,232,693 of all other kinds.

In the rural districts the use of the telephone has greatly lessened the labor of sheriffs and constables in connection with the suppression of the "tramp nuisance."

The Pennsylvania Railroad's Extension to New York and Long Island.

The Passenger Station in New York.

THE new Pennsylvania Railroad station in New York, for which the plans are now practically perfected, will be unique among all the railway stations of the world in the number and convenience of its entrances and exits. This condition is due to the fact that each of the four sides of the structure is a front, opening respectively on two wide avenues and two important streets, which latter have been widened by the company to eighty feet each.

The geography of the station is interesting. It is bounded on the east by Seventh and the west by Eighth avenue; on the south by Thirty-first and the north by Thirty-third street, Thirty-second street having been closed and included in the station site. In the centre of the hotel, theatre and shopping district the advantage of its location is obvious. The frontage on the avenues is 430 feet and on the streets 780 feet, the sides of the structure forming a perfect parallelogram. As the tracks are forty feet below the surface of the streets the station is divided into three levels. From the street level upward the walls of the structure rise to the height of sixty feet, except in the centre, where the roof of the general waiting room reaches a height of 150 feet, and the corner of Eighth avenue and Thirty-third street where there is an elevation of four stories for office purposes. The architectural design of the entire exterior is a Doric colonnade, thirty-five feet high, surmounted by a low attic, raising the general elevation to sixty feet. The unusual extent of the building in area and its general type are suggestive of the great baths of ancient Rome. In fact, the baths of Caracalla, still magnificent in their ruins, were the inspiration of this architectural plan.

Although the building is low by contrast with its skyscraping neighbors, its scope makes it impressive, and the lofty roof of the waiting room, rising high above the top of the surrounding structure, with its eight large semi-circular openings, seventy-two feet in diameter, adds dignity to the group of buildings and at the same time makes them a conspicuous landmark, when seen in perspective from the streets. In appearance it is a wide departure from the conventional railway station. One misses the turrets and towers and, more than all, the lofty arched train shed, but as the principal function of this station is performed underneath the streets, the upward and visible signs of the ordinary railway station are naturally absent. It will rather resemble some vast auditorium constructed on low lines for the easy ingress and egress of a multitude of people.

The exterior construction is to be of pink Milford granite, similar to the building stone of the Boston Public Library, the University Club of New York, the Court House in Pittsburg and the Chamber of Commerce in Cincinnati. This is a particularly effective structural stone, and its soft shades of color are uncommonly pleasing to the eye.

The main entrance is fixed in the centre of the structure on Seventh avenue, opposite the intercepted end of Thirty-second street. This is for foot passengers only, and from the street entrance to the stairway to the main waiting room there extends an arcade 225 feet long and forty-five feet wide flanked by shops, which will be occupied by merchants whose wares will appeal especially to the requirements of travelers. On either side of the Seventh avenue entrance there are also a series of stores. At the further end of the arcade the restaurant, lunch rooms and the café are established, with proper kitchens and service connections. Beyond is the general waiting room and the concourse, all easy of access by convenient stairways.

At the corners of Thirty-first and Thirty-third streets and Seventh avenue are open pavilions, which furnish carriage entrances for incoming and outgoing traffic. Under cover carriages descend from the street level by a slight gradient about twenty feet to the level of the station proper, the Thirty-first street incline being assigned as an entrance and the Thirty-third street ascent as an exit. By this arrangement carriage passengers are delivered at the most convenient entrance to the general waiting room.

Apart from the main entrance there are other convenient entrances for foot passengers from the street level to the general waiting room and concourse from both the streets and the avenues. At a central point in both streets wide bridges leading into the street floor of the station span the carriage subway.

On the intermediate plane or level the real business of the passenger preparatory to his journey is transacted.

The general waiting room, the largest of its kind in the world, 320 feet long, 110 feet wide and 150 feet high, is the central section of the plan. Within its spacious walls will be located the ticket offices, parcel rooms, telegraph and telephone offices and baggage-checking windows, all so disposed as to situation that a passenger may proceed from one to the other seriatim, with a minimum amount of exertion and without retracing his steps.

Adjoining the general waiting room on the west are two subsidiary waiting rooms, fifty-eight by 100 feet, respectively for men and women, provided with seats, and opening into retiring rooms, with lavatories attached.

To the east of the general waiting room the main baggage room, with 450 feet of frontage, for the use of the transfer wagons, is located, covering the full area occupied by the arcade and restaurants on the plane above. The baggage is delivered and taken away through a special subway, thirty feet wide, extending under and along the entire length of Thirty-first street and Seventh and Eighth avenues. From the baggage room trunks are delivered to the tracks below by motor trucks and elevators.

The cabstands will also occupy this level. There will be maintained an ample service of electric vehicles of varying capacities to meet the requirements of the hosts of travelers.

Parallel to and connecting with the main waiting room by a wide thoroughfare, and west of the subsidiary waiting rooms, is the concourse, a covered assembling place over 100 feet wide, extending the entire width of the station and under the adjoining streets. An idea of the width of this concourse is gained by a comparison of it with the lobby of the Jersey City train shed, which is narrower by twenty-five feet. This may be termed the vestibule to the tracks, as two sets of stairs descend from it to each of the train platforms on the track level. The concourse and adjacent areas are open to the tracks, forming a courtyard 340 feet wide by 210 feet broad, roofed by a lofty train shed of iron and glass, similar in design to the famous train sheds of the new stations in Frankfort and Dresden, Germany. In addition to the entrances to the concourse from the waiting room there are also direct approaches from Thirty-first, Thirty-third streets and Eighth avenue.

The gates of the stairs descending from the concourse to the trains will bear signs

announcing the name, destination and the time of departure of the train on the particular platform where the stairs land.

Auxiliary to the main concourse, and located between it and the tracks, is a subconcourse, sixty feet wide, which will be used for exit purposes only. This passageway is eighteen feet above the tracks, but is connected with the track level by two stairways and one elevator from each platform. From it ample staircases and inclines lead directly to Thirty-first, Thirty-third and Thirty-fourth streets, to Eighth avenue and to future rapid transit stations under Seventh or Eighth avenues. Direct connection may also be made with the proposed subway stations on Herald square without ascending to the street level.

The northern side of the station extending along Thirty-third street will be assigned to the suburban service of the Long Island Railroad, into which trains will run from all points on Long Island by way of the East river tunnels. Ample entrances and exits are provided on Seventh and Eighth avenues and Thirty-third street, so that this traffic can be handled in connection with the adjacent subways and the surface lines on the surrounding streets independently of the rest of the station.

The third level, which is at a depth below the surface of the street corresponding to the height of a four-story building, is the track level. When the two tracks emerge from the tubes under the Hudson and reach the entrance to the station yards at Tenth avenue they begin to multiply, and at Ninth avenue, and extending into the station, the total number has grown to twenty-one. There is also a reduction in the number of tracks leading out of the station to the east, to a total of four for the main line, two passing under Thirty-second and two under Thirty-third street, and thence under the East river to the Long Island City yards. The track surface of the station may be compared to two unfolded fans joined together at the open ends, the handle of one extending under the Hudson and that of the other under East river. Within the station area, covering twenty-five acres of ground space, there are sixteen miles of tracks. This trackage area will afford ample facilities for easy movement of many hundred trains per day by the prompt and efficient means of electric power. Through trains from the western side of the Hudson, after discharging passengers, will proceed at once to Long Island City, where the train yards and terminals will be located, thus leaving the station tracks clear of any idle equipment, and likewise the westbound through trains made up at the Long Island City terminal will pass through the station, stopping only to take up their quota of passengers. The suburban service of the Long Island Railroad will be operated on the "shuttle" plan, by which the trains are kept in continuous motion in and out of the station.

The planning of the station, with its numerous entrances and exits independent of each other and separating the incoming from the outgoing throng, was worked out to facilitate, in greatest measure, the prompt and uninterrupted movement of the traffic.

The exposure of the building on all four of its sides to main arteries of street traffic gives the plan a flexibility which is rarely obtainable in a building of such enormous proportions situated in the heart of a great city, and also insures the making of easy connections by underground subways with the future extensions of the city's rapid transit system under Seventh and Eighth avenues and the cross streets.

The designs for the station were made by McKim, Meade & White, architects, of New York, and will be executed under their direction.

PENNSYLVANIA RAILROAD STATION, NEW YORK CITY.

ON METHODS WHEREBY THE RADIATION OF ELECTRIC WAVES MAY BE MAINLY CONFINED TO CERTAIN DIRECTIONS, AND WHEREBY THE RECEPTIVITY OF A RECEIVER MAY BE RESTRICTED TO ELECTRIC WAVES EMANATING FROM CERTAIN DIRECTIONS.[1]

BY G. MARCONI.

This note relates to results observed when for the usual vertical antenna employed as radiator or absorber in wireless telegraph stations there is substituted a straight horizontal conductor placed at a comparatively small distance above the surface of the ground or water.

When an insulated horizontal wire, AB, such as is shown in sketch 1, is connected at one end to a sphere of a spark-gap, the other sphere of which is earthed, and sparks are caused to pass between the spheres, it will be noticed on investigating the space around such an oscillator that the radiations emitted reach a maximum in the vertical plane of the horizontal wire AB and proceed principally from the end A, which is connected to the spark-gap, while the radiation is nil, or reaches a minimum, in directions which are approximately 100 degrees from the direction in which the maximum effect occurs.

I have also noticed that any horizontal conductor of sufficient length placed upon or at a short distance above the surface of the ground, and connected at one end through a suitable detector to earth, will receive with maximum efficiency only when the transmitter is situated in the vertical plane of the said horizontal receiving conductor, and in such a direction that the end connected to the detector and to the ground is pointing toward the transmitting station.

If, therefore, such a horizontal conductor be swiveled about its earthed end in a horizontal plane, the bearing or direction

[1] Paper read before the Royal Society, March 22. Communicated by Dr. J. A. Fleming, F. R. S.

of any transmitting station within range of the receiver can be ascertained.

I have carried out a number of tests with transmitters and receivers having radiating or receiving antennæ or conductors arranged as follows:

1. Transmitting conductors consisting of horizontal wires, the radiations being

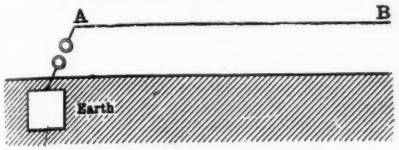


FIG. 1.—WIRELESS SYSTEM WITH STRAIGHT HORIZONTAL ANTENNA.

received at a distance by means of the usual vertical wires suitably attuned.

2. Both transmitting and receiving conductors consisting of horizontal wires.

3. Transmitting conductors consisting of one or more vertical wires with or without capacity areas at top, such as have been generally employed in wireless telegraphy, the radiations being received by means of horizontal conductors.

At long distances I almost invariably used as a detector my magnetic receiver.[1] At shorter distances I utilized a Duddell thermo-galvanometer[2] by means of which it was possible to measure the root-mean-

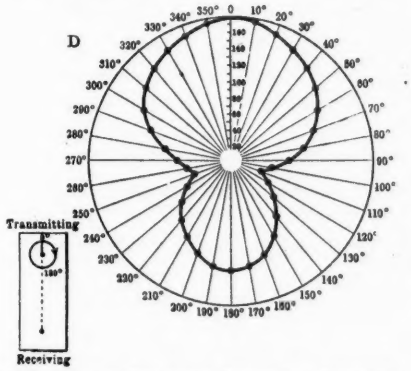


FIG. 2.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: horizontal, rotating from 0 degrees to 360 degrees, 1.5 metres above ground. Receiving conductor: vertical, fixed; height, 18 metres. Length of transmitting conductor: 60 metres. Receiving conductor: 18 metres. Distance of transmission, 260 metres.

square values of the currents induced by the oscillations in receiving wires disposed in various positions relative to the transmitting conductors.

With arrangements such as are referred to in (1), the following tests have been carried out:

1. Transmitter—Horizontal wire 100 metres in length, direct excitation, spark length two centimetres, wave-length, approximately 500 metres.

Receiver—A vertical wire eight metres in length, tuned to the period of the transmitter by means of a syntonizing coil, and connected to a magnetic detector and to earth in the usual manner.

Results—Signals quite distinct at sixteen kilometres in the vertical plane of the horizontal transmitting wire and in the direction of its earthed end; weak at ten kilometres in the same vertical plane, but in the reverse direction; inaudible at six kilometres at right angles to the directions above mentioned.

2. Transmitter—(At Mullion, Cornwall); consisting of horizontal conductor 150 metres in length, composed of four parallel wires about three millimetres in diameter, placed 1.50 metres apart, supported at a height of twenty metres, and all connected to earth through the spark-gap of an induction coil placed in a building on the ground; spark-length about two centimetres.

Receiver—At the Haven, Poole (distance 240 kilometres); consisting of vertical wire fifty metres long, connected through a syntonizing coil to a magnetic detector and to earth.

Results—A movement of fifteen degrees of the plane of the transmitting conductor out of the right direction was sufficient to cause signals to become indetectible at Poole.

Polar diagram D (Fig. 2) gives the values of the received current in micro-amperes, with conditions as marked under the diagram. The values of current in micro-amperes shown in each diagram are the mean of a considerable number of readings, the transmitted energy being kept as nearly as possible constant by means of a suitable interrupter applied to the sending induction coil.

With the arrangement mentioned at (2) —*i. e.*, both transmitting and receiving conductors horizontal, the following results, among others, were obtained:

1. Transmitter—Conductor 200 metres in length, supported at a height of fifteen metres above ground; spark length about two centimetres.

Receiver—Similar conductor supported one metre above ground connected at one end to a detector and to earth as usual.

Results—In the direction for maximum effect (as already explained) readable signals at twenty-five kilometres. At about ninety degrees from said direction at twelve kilometres, nothing; in the same direction at five kilometres, weak signals.

2. Transmitter—Consisting of four wires each 330 metres in length, separated from one another by a distance of 1.4 metres, supported at a height of twenty metres above ground and connected by means of a nearly vertical conductor to a spark producer; spark length three centimetres.

Receiver—Consisting of one wire 220 metres in length, covered with insulating material, placed on the ground and connected to the end nearest the sending station through a syntonizing coil to a magnetic receiver and to earth.

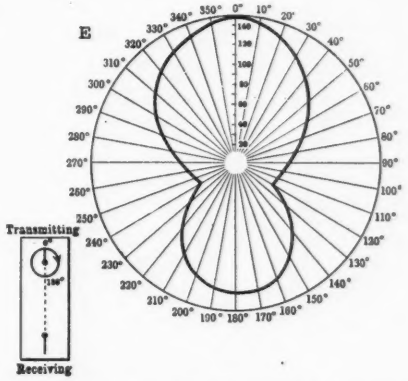


FIG. 3.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: horizontal, revolving from 0 degrees to 360 degrees, 1.5 metres above ground. Receiving conductor: horizontal, fixed, 1.5 metres above ground. Length of transmitting conductor, 60 metres. Receiving conductor, 60 metres. Distance of transmission, 260 metres.

Results—When in the vertical plane of the transmitting antennæ, and in the best direction, weak but distinct signals were received at a distance of 160 kilometres; at 45 degrees from said direction and at

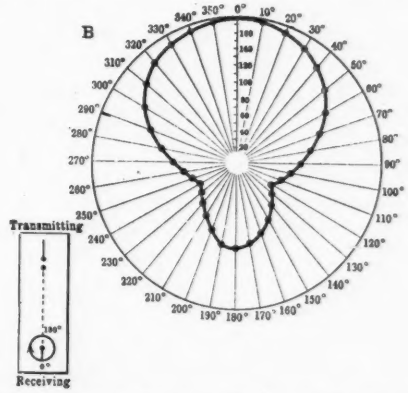


FIG. 4.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: horizontal, fixed, 1.5 metres from ground. Receiving conductor: horizontal, rotating from 0 degrees to 360 degrees, 1.5 metres from ground. Length of transmitting conductor, 30 metres. Receiving conductor, 30 metres. Distance of transmission, 225 metres.

150 kilometres distance nothing was received; at twenty-five degrees from the best direction, and at 160 kilometres distance, very weak signals were received.

The results over shorter distances are given by the readings obtained on the ther-

[1] See *Proc. Roy. Soc.*, London, 1902, vol. lxx, p. 341.
[2] *Phil. Mag.* 1904, vol. viii, p. 91.

mo-galvanometer, and are shown in the polar diagrams E and B.

With arrangements such as are mentioned at (3)—*i. e.*, the transmitting conductor consisting of the usual vertical type and the receiving conductor horizontal, the following results among others merit attention:

At Clifden, Connemara, Ireland, by means of a horizontal conductor 230 metres in length, laid on the ground and connected at one end to a magnetic receiver and to earth, it is possible to receive with clearness and distinctness all the signals transmitted from the Poldhu station (situated 500 kilometres distant) provided that the free end of the said conductor points directly away from the direction of Poldhu. No signals can be received if the horizontal wire at Clifden makes an angle of more than thirty-five degrees with the line of direction of Poldhu.

The signals from the Admiralty station at Scilly can be received at Mullion, Cornwall (distance about eighty-five kilometres), by means of a horizontal wire fifty metres in length, two metres above ground, provided said wire is placed in a radial position with respect to the sending station and with its free end pointing away from it. But it is unreceptive if placed so as to make an angle of more than twenty degrees with the line of direction of the station at Scilly.

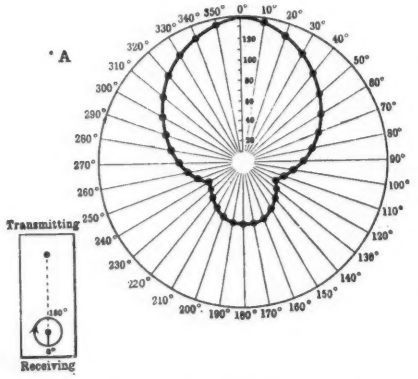


FIG. 5.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: vertical, fixed; height 44 metres. Receiving conductor: horizontal, rotating from 0 degrees to 360 degrees, 1.5 metres above ground. Length of transmitting conductor, 45 metres. Receiving conductor, 30 metres. Distance of transmission, 680 metres.

Some tests have also been carried out for the Admiralty in the vicinity of Poldhu in conjunction with H. M. S. Furious. For this purpose eight horizontal wires, sixty metres in length, supported at a height of about two metres, were arranged radially and made to converge in a small building situated in a field near Poldhu. These radial wires were so arranged as to divide the circle into eight equal sectors. By means of a suitable switch any one of the ends of these wires at the position where they converge together could be connected to earth through a magnetic receiver.

The wireless telegraph station on H. M. S., Furious, consisted of an ordinary vertical wire aerial, about fifty metres in length, connected to a suitable spark-gap. The station on the ship transmitted at intervals, and the ship followed a course describing an arc of about 180 degrees around Poldhu, keeping at distances varying up to sixteen miles. By means of the horizontal wire arrangement the bearing of the ship from Poldhu could be determined at any time by noting on which particular wire or wires the reception of signals was strongest, and also by observing which wires were non-receptive.

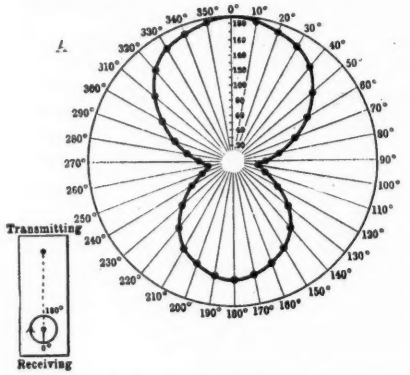


FIG. 6.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: vertical, fixed; height, 44 metres. Receiving conductor: horizontal, rotating from 0 degrees to 360 degrees on ground. Length of transmitting conductor, 45 metres. Receiving conductor, 30 metres. Distance of transmission, 680 metres.

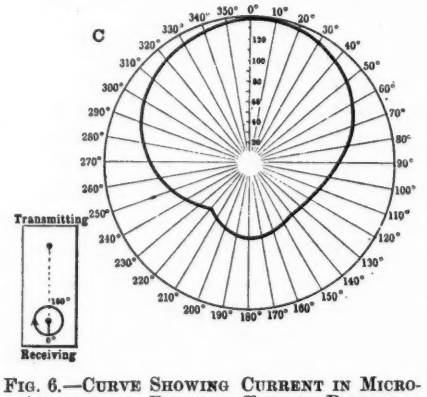


FIG. 6.—CURVE SHOWING CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: Poldhu Station Aerial, consisting of multiple-vertical conductors with large capacity at the top. Receiving conductor: horizontal, rotating from 0 degrees to 360 degrees, 1.5 metres above ground. Length of receiving conductor, 30 metres. Distance of transmission, 650 metres.

It was also found possible to receive simultaneously and without mutual interference different signals sent by means of oscillations of the same wave-length coming from the ship and from the Lizard wireless station (ten kilometres away), whenever the ship was in such a position that its bearing from Poldhu made an angle of at least fifty degrees with the bearing of the Lizard station.

For further values and curves of received current in receivers I refer to diagrams A, A′, C, C′.

Referring generally to the results mentioned in this note, I have observed that, in order that the effects should be well marked, it is necessary that the length of the horizontal conductors should be great in proportion to their height above the ground, and that the wave-lengths employed should be considerable— a condition which renders it difficult to carry out such experiments within the walls of a laboratory.

I have found the results to be well marked for wave-lengths of 150 metres and over, but have not been able to obtain as well-defined results when employing much shorter waves—the effects following some law which I have not yet had time to investigate. There also appears to be a decided advantage in so far as effects at long distances are concerned in utilizing a directly excited radiating conductor —that is, an insulated conductor in which the high-frequency oscillations are started by means of a suitable spark discharging it to earth or to another body, as was usual in my early forms of Hertzian-wave wireless telegraph transmitters.

If inductive excitation is employed, that is, if the oscillations are induced in the radiating conductor from another oscillating circuit, the comparative results in various directions appear to be in the same

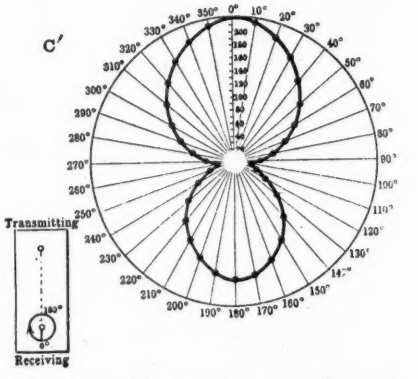


FIG. 8.—CURVE SHOWING OBSERVED CURRENT IN MICRO-AMPERES AT EARTHED END OF RECEIVING CONDUCTOR UNDER THE CONDITIONS OF DIRECTION SHOWN BELOW.

Transmitting conductor: Poldhu Station Aerial, consisting of multiple-vertical conductors, with large capacity at the top. Receiving conductor: horizontal, rotating from 0 degrees to 360 degrees on ground. Length of receiving conductor, 30 metres. Distance of transmission, 650 metres.

proportions as those noticed when using the method of simple excitation, but the distances over which the effects can be detected are much smaller at parity of the power employed at the transmitter.

I have noticed that the most advantageous length of the receiving horizontal wires, in order to obtain results at maximum distances, is about one-fifth of the length of the transmitted wave, if said wires are placed at a distance above the ground; but the receiving wires should be shorter if placed on the ground. It would be instructive to investigate more thoroughly the difference of the results and curves obtained by means of horizontal wires placed at different heights above ground, and also the effect of varying the length of said wires.

When using horizontal receiving wires arranged as described in this note, I have often noticed that the natural electrical perturbations of the atmosphere or stray electric waves, which are generally prevalent during the summer, appear to proceed from certain definite directions, which vary from time to time. Thus, on certain days the receiving instruments, when connected to wires which are oriented in such a way as to possess a maximum receptivity for electric waves coming from the south, will give strong indications of the presence of these natural electric waves, while on differently oriented wires the effects are at the same time weaker or imperceptible. On other days these natural electric waves may apparently come from other directions.

It would be exceedingly interesting to investigate whether there exists any relation between the direction of origin of these waves and the known bearing or direction of distant terrestrial or celestial storms, from whence these stray electric waves most probably originate. A considerable number of observations would be necessary to determine whether there exists any relation between the bearing of storm centres and the direction of origin of these natural electric waves. I propose to carry out some further investigations on the subject.

I ought to explain that the experiments described in this note were carried out during a period of many months, and that as other results achieved over greater distances coincide generally with those here described, I have not thought it necessary to make special reference to them.

I should also mention that the tests over short distances were carried out over practically flat country, whilst those over considerable distances took place over hilly country, such as the West of England, and in some cases partly across sea and partly across land.

The Twenty-Ninth Convention of the National Electric Light Association.

The following partial list of papers has been announced for the twenty-ninth convention of the National Electric Light Association, Atlantic City, N. J., June 5-8:

PAPERS FOR TWENTY-NINTH CONVENTION.

"Report of Committee on Rates and Costs," by Chas. L. Edgar, chairman. Discussion by A. S. Knight, Alex. Dow, Robert Lindsay, E. M. Lloyd, R. W. Royce.

"Business-Getting Methods," by Frank Frueauff.

"Report on Theft of Current," by C. T. Mordock.

"Laws Concerning Theft of Current," by E. H. Davis.

"Fuel Economics," by J. H. Hallberg.

"Alternating-Current Systems of Distribution and their Automatic Regulation," by Charles W. Stone.

"Some Methods Used in Securing and Retaining Business," by Norman T. Wilcox, George N. Tidd, George B. Tripp, M. E. Turner, Leon H. Scherck, R. S. Wallace.

"Line Construction for Overhead Light and Power Service," by Paul Spencer.

"Alternating-Current Elevators," by W. N. Dickenson, Jr.

"Mechanical Refrigeration," by John Meyer.

"How to Make Small Electric Plant Pay," by D. F. McGee.

"The Edison System of Southern California," by R. H. Ballard.

"Modern Switchboard Practice with Particular Reference to Automatic Devices," by E. M. Hewlett.

"Report on Protection from Lightning During 1905," by Alex. Dow, chairman; C. A. Honnold, Robert S. Stewart.

"The London Sliding Scale as a Method for the Government Regulation of Public Service Corporation," by W. H. Gardiner, Jr.

"Report of Committee on Fire Hazards of Electricity," by H. C. Wirt, chairman; C. E. Skinner, A. A. Pope.

"Report of Committee on Progress," by T. C. Martin.

"Higher Efficiency Incandescent Electric Lamps in Central Station Service," by Francis W. Wilcox.

"Mercury Arc Rectifier with Magnetic Lamps for Street Illumination," by W. S. Barstow.

"The Maintenance and Calibration of Service Meters," by William Bradshaw.

"Report of Committee to Co-operate with Manufacturers' Advertising Committee," by Paul Spencer.

"Control of Motors on Electric Light and Power Circuit," by H. D. James.

"Design and Manufacture of Hydroelectric Installations as a Whole," by E. F. Cassel.

BOOK REVIEW.

"The Electrical Nature of Matter and Radioactivity." Harry C. Jones. New York. D. Van Nostrand Company. Cloth. 212 pages. 5½ by 8¼ inches. Supplied by the ELECTRICAL REVIEW at $2.

As the contents of this book have already appeared as a series of articles in the ELECTRICAL REVIEW, but little need be said about it. Dr. Jones has been unusually successful in his efforts to treat a strictly scientific subject in a popular way. It is not difficult to avoid mathematical formulæ, but it is not always easy to explain clearly, so that those who are not deeply versed in physical arguments can follow and understand, the deductions resulting from the analytical method of attack, which has been so essential in securing us new knowledge in this branch of physics. The subject itself, the electrical nature of matter, and that closely related one, radioactivity, are of much popular interest, for the public feels, in a measure, the scientific importance of the new developments in physics. For those who have merely a slight curiosity to hear a wonderful tale of the latest physical marvels this book will not appeal; but to that large class which is deeply interested in scientific advance, and which follows, as closely as it can, all new work, this book will be welcome. It will be found clear and accurate, and it brings the subject down to the present time. Dr. Jones treats the subject first by discussing the conduction of electricity through gases and the results which have followed from a study of this phenomenon. Work in this direction leads to the explanation of the corpuscle and the electrical theory of matter, and hence to a discussion of the chemical atom and the effect of the new theory on chemical ideas. From this point a study of obscure radiations is taken up, beginning with X-rays, and then the action of those peculiar substances now designated as radioactive. Radium and its supposed decomposition products are fully considered, as well as the action of these bodies on other materials. In all cases Dr. Jones goes to the fountain-head for his information, and the facts which he presents here can not be questioned. These investigations, as he says, mark a new epoch in the development of the physical sciences, for facts have been brought to light which are of a character that is very different from anything hitherto known and to which we must now adapt ourselves.

The Hawthorne Shops of the Western Electric Company.

THE Hawthorne shops of the Western Electric Company consist of six principal groups of buildings. The office, foundry, forge shops and machine shops, devoted to the manufacture of direct and alternating-current motors and generators, are located on the west side of the belt railway. The cable and rubber plants, devoted to the manufacture of telephone and power cables, and rubber in the various forms in which it is used for telephone service, are located on the east side of the railway.

In addition to these buildings there are a gas plant, water tower, power plant and two crematory buildings. The entire plant covers approximately 1,000,000 square feet of floor space and is located on a tract of land of 110 acres. The Chicago Terminal and Manufacturers' Junction Railway tracks pass through the property and connection is made by an elevated spur track to the main line of the Chicago, Burlington & Quincy Railway.

The grounds are artistically laid out and the driveways connecting all the buildings are paved with concrete block.

The foundry is a brick and steel structure, having a Luci Viti tile roof, and is 400 × 176 feet, and seventy-five feet at its highest point. It is divided into three bays. Over the centre, or main bay, which is for large work, are located two thirty-ton cranes. The west bay is seventy-five feet wide and has a low roof; it being used exclusively for bench work. The east bay, which is thirty feet wide, is divided into sections containing the cupolas, storage bins and core ovens.

The machine shop, lying at right angles to the foundry, is 860 feet long and 150 feet wide, and is of the same type of construction as the foundry, except the roof, which is of iron and tarred roof construction. There are three bays: the centre one, seventy-six feet wide, is devoted to the manufacture of generators and motors. The north bay, forty-eight feet wide, contains such machine tools as are required in the manufacture of small types of machines. In this bay is located the testing department. The south bay has two floors, the upper one being devoted to the manufacture of small field coils and the winding of small armatures. It also contains the small detail and finishing departments. The lower floor contains the commutator and large detail departments, stock rooms and general shop offices, including that of the shipping department. The lighting is obtained from overhead skylights and side windows. Over the main bay are located two thirty-ton and over the north bay six twenty-ton cranes. The entire plant is equipped with a system of industrial railways.

CABLE PLANT.

Entering the cable plant from the south is a railway track connecting the receiving department, which covers 15,000 square feet, at which the raw material is received. Adjacent to this are the insulating and wire-twisting departments, covering 22,500 square feet, and from which the material passes into the cable-twisting room, covering the same area. From here the cable passes into ovens, covering an area of 10,000 square feet, and is finally delivered through small openings in the wall to the pressroom, where the lead sheath is applied. This room is 360 × 100 feet. At the south end is located a storage pit for lead, in which under normal conditions is stored 4,000,000 pounds.

Immediately adjoining this section is a room 100 × 50 feet, in which is a battery of six impregnating tanks, used in the insulating of power cables made in another adjoining room, covering 15,000 square feet.

In addition to these departments there are the testing and shipping sections, covering an area 440 × 50 feet.

There are in process of construction, and almost completed, buildings which will increase the capacity of the present plant over 100 per cent.

The rubber plant forms an L to the cable plant and is located immediately south, with an open space or court 200 feet square, dividing it from the cable plant, which is used for the storage of cable reels. It has the same railroad connection as the cable plant, and is divided into four sections: the compound mixing, grinding and vulcanizing, sawing and finishing and shipping rooms, all covering an area of 40,000 square feet. A portion of this plant is two stories high; the second floor being devoted to the process of drying crude rubber. The buildings of the cable and rubber plants are identical in that they are of brick and steel construction—a special feature being a saw-tooth roof construction, so built that the windows face the north. This type of roof is used entirely in this section of the plant, except in the pressroom of the cable shops, where crane service is furnished by one twenty-ton and one five-ton crane, and in that portion of the rubber plant having two stories.

POWER PLANT.

The boiler room has an area of 20,700 square feet and is designed for two chimneys, each twelve feet inside and twenty-two feet outside diameter, and 250 feet in height above the boiler room floor. One of these chimneys has been built and the other is in process of construction. Provision has been made for two batteries of boilers of eight each, a chimney dividing each battery into two sets of four. At present there has been installed eight boilers of Aultman & Taylor Company's make, each with a heating surface of 5,080 square feet and operating at 150 pounds. Contracts have been made for increasing the boiler capacity twenty-five per cent. The present boilers are so arranged that superheaters may be installed at a later date should it be thought advisable.

Aultman & Taylor Company's chain grate stokers are used having a grate area of seventy-seven square feet. Each set of four boilers is provided with a Green fuel economizer of sixty-eight sections, twelve tubes wide. The water tubes of the boilers are cleaned by means of a hydraulic-driven cleaner supplied with water from a 7½ × 5 × 6-inch Deane duplex pump.

The main railroad tracks dividing the company's property afford an easy means of handling the coal, as they are of such a height that cars may be switched by means of an elevated spur track into the storage bins located above the boiler room. These bins are of 1,000 tons capacity and are so designed that the coal may be discharged through spouts into a hopper scale for each division of boilers. This scale is mounted on a track, so as to take the coal from any part of the bin and deliver it to any one of the stokers. The ash is discharged at the end of a chain grate stoker into a bin of one and one-half tons capacity, located below each boiler. From these bins the ash may be delivered into gondola cars and taken by means of a depressed railroad track to various places about the plant where filling may be required.

The continued uncertainty of the coal supply, due to strikes and other conditions beyond the control of the manufacturer, has led to a careful consideration of the problem of coal storage. The Western Electric Company, after carefully investigating the question, decided to follow the practice adopted by the British Admiralty. Two storage bins, one of 4,000 and the other of 10,000 tons capacity, both located below the normal ground level, have been

constructed, into which coal may be dumped from cars and taken out by means of a locomotive crane fitted with a grab bucket. Carefully executed tests in Europe show that nearly thirty per cent of the heating value of coal is lost in six weeks when stored exposed to the air. By keeping the bins flooded the company expects to reduce the losses of the coal to approximately two per cent of its heating value after six months to a year storage. By this system of storage there is provided sufficient coal to operate the plant under normal winter conditions for four months.

A Cochrane open feed-water heater of 8,000 horse-power capacity and two 14 × 10 × 15-inch Worthington "Duplex" vertical type boiler feed pumps are located in the boiler room.

The engine room and condenser pit have a total floor space of nearly 16,000 square feet and contain a power plant of a capacity for continuous service of 3,000 kilowatts and for two-hour service of 4,500 kilowatts. There are four units, one each of 300, 500, 1,000 and 1,200 kilowatt capacities.

The larger generator is driven by a vertical cross-compound Rice & Sargent engine made by the Providence Engine Works. The diameters of the cylinders are 32 inches and 62 inches, the stroke 48 inches and the piston speed 800 feet per minute, the revolutions per minute being 100. The 300 and 500-kilowatt generators are driven by a horizontal cross-compound engine and the 1,000 kilowatts by a vertical cross-compound made by the Filer & Stowell Company. The cylinder diameters, stroke, piston speed and revolutions per minute are as follows:

300 kilowatts,	16″ × 32″ cylinders,	700 feet per minute,	100 R. P. M.
500 kilowatts,	20″ × 40″ "	700 " " "	100 R. P. M.
1000 kilowatts,	30″ × 60″ "	640 " " "	80 R. P. M.

Three Wheeler surface condensers are located in the condenser pit, two of 3,200 square feet and one of 4,500 square feet cooling surface; also three Blake "Duplex" single-acting air pumps, 7½ × 16 × 10-inch units for the smaller condenser and 9 × 20 × 12-inch units for the larger condenser. The condenser water is obtained from a reservoir of 5,000,000 gallons capacity, which is primarily for fire protection purposes. Two 1,500-gallon-per-minute fire pumps derive their supply from this reservoir.

Two ten-inch and one twelve-inch motor-driven centrifugal pumps are used for circulating the water and operate under a load of thirty-seven and forty-five horse-power, respectively. These pumps are called upon to furnish only sufficient power to overcome the friction of the pipes, as the condensers are located below the level of the water in the reservoir, the suction and discharge pipes being submerged.

A twenty-ton crane with a five-ton auxiliary hoist is located over the engines, and a fifteen-ton crane over the condenser pit.

In addition to the reservoir previously referred to, a water tower of artistic design has been provided in which are located six steel tanks with a total capacity of 213,000 gallons, connected with the sprinkler system, the bottom of the lowest tank being thirty-eight feet above the highest sprinkler in the plant. Means are also provided for connecting these tanks with the hydrants throughout the plant. The water tower also has tanks containing water for sanitary purposes. City water is used in both the reservoir and the tower.

Drinking water is obtained from a shallow well, 300 feet deep, at the rate of forty gallons per minute by a direct-acting deep well pump and is piped to all departments. The water has a temperature of about fifty-six degrees Fahrenheit.

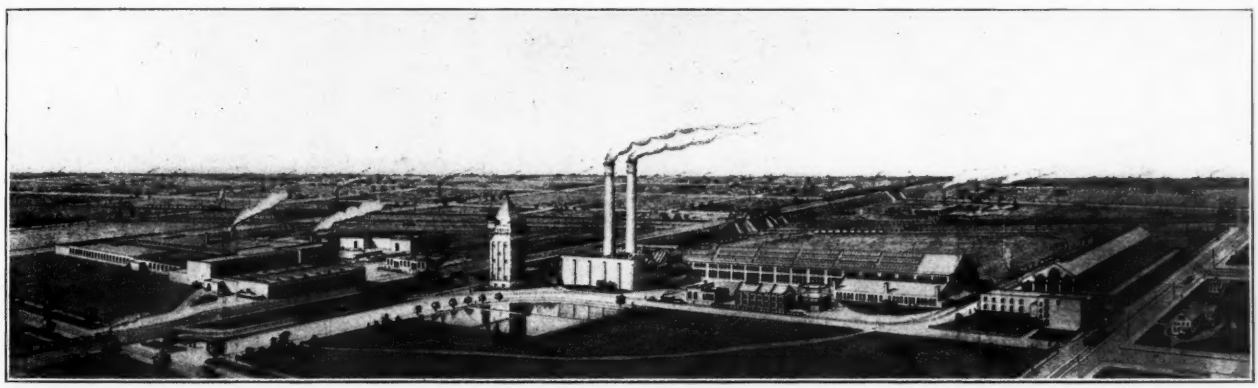
Compressed air is used for the purposes of pneumatic tools, blowing out cables and electric machinery, and operating moulding machines. The entire plant is supplied with air at ninety pounds pressure by a 20 × 12 × 18-inch Laidlaw-Dunn-Gordon two-stage air compressor direct-driven by a 12 × 19 × 18-inch compound engine fitted with a Myer release gear and located in the condenser pit.

Uncarburetted water gas, used in the heating and baking ovens and annealing furnaces about the plant, is furnished by two generators, each with a capacity of 25,000 cubic feet per hour. The gas is stored in a tank of 100,000 cubic feet capacity and has a heating value of approximately 300 British thermal units. It is made from a good grade of furnace coke, and costs, exclusive of fixed charges, such an amount as to compete favorably with 12,000 British thermal units coal at $2.80 per ton. It has approximately fifty per cent of the heating value of, and costs fifty per cent less than city gas.

There is now being constructed a 200,000 cubic foot tank, the use of which will enable the company to run one gas generator during the entire twenty-four hours with pronounced economy over present conditions, which require both generators to work at certain times of the day.

All buildings are heated by direct radiation except the foundry and machine shops, the foundry being equipped with a hot-air system furnished by the New York Blower Company, while the machine shop has a combined direct radiation and hot-air system using the Garden City Fan Company's apparatus. The heating coils are supplied with steam under the Warren-Webster system. Two 8 × 14 × 16-inch Blake "Simplex" vacuum pumps are used in connection with the system.

In the winter time one or more engines are operated non-condensing, the steam circulating under slightly less than atmospheric pressure. The efficiency of the



BIRD'S-EYE VIEW, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

above arrangement is apparent when it is considered that during last winter no steam was required for heating other than that furnished by the exhaust of the engine.

The crematory, having an area of approximately 1,600 square feet, cares for the shavings and chips from the carpenter shops. It contains a boiler and Dutch oven specially designed for the purpose. Provision for a 100 per cent increase in capacity has been made.

The carpenter shops are equipped with an exhaust system from the various machines, and are provided with an edging hog which grinds the larger scrap lumber into shavings small enough to pass through the exhaust pipes into the crematory boiler, which is directly connected to the main steam line. Under normal conditions there are evaporated about 400 gallons of water per day to a pressure of 160 pounds per square inch, augmenting the steam supply.

FIRE PROTECTION.

Realizing fully the serious results to the business of the company of temporarily crippling even one of the departments of the plant, careful consideration has been given to the fire hazard; neither money nor thought has been spared to reduce this hazard to a minimum and to provide means to quickly control any blaze that might break out. The result has been that the company is saving yearly large sums of money in its insurance cost, and they now feel that as a result of the money expended, there has been produced a manufacturing plant in which the fire hazard has been reduced to a minimum.

An engineer trained in the inspection of manufacturing properties, devotes his entire time to the fire-protection devices and to the safeguarding of all the processes of manufacture. In general, the different departments have one-story buildings by themselves, each far enough removed from its neighbor to eliminate the danger of fire spreading. Large areas are divided by heavy fire walls with double tin-clad fire doors at the openings.

The walls are of brick, with wire-glass windows at exposed points, and the floors of concrete or concrete with wooden surface. The roofs are tile on structural steel.

With the exception of three buildings, the property is protected throughout by automatic sprinklers. The three exceptions are the foundry, forge shop and main body of the machine shop, in which there is absolutely no combustible material.

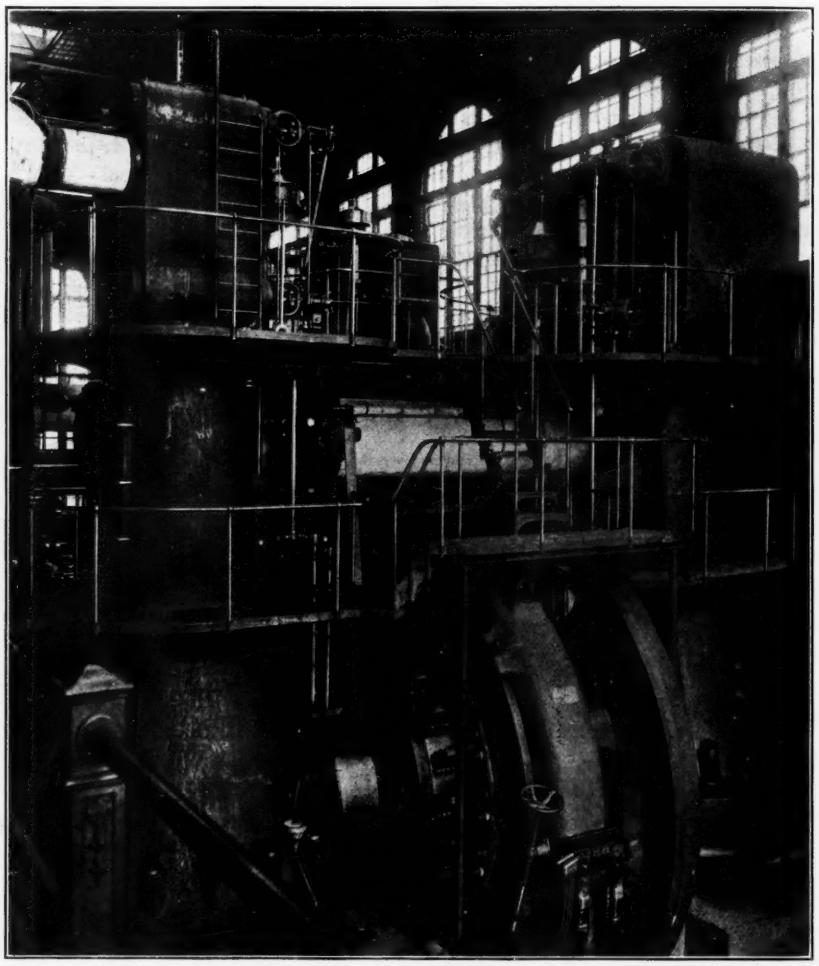
An interesting feature is a circle of sprinkler pipes with heads on the sides of each steel post supporting the roof in the machine shop. These heads are about fifteen feet above the floor and are designed to protect these posts from danger that may arise from inflammable material gathering about their bases. The sprinkler system is supplied with water through an elaborate yard system of about 13,000 feet of ten and twelve-inch water pipe, the feed into each building being controlled by a gate with a post indicator, so that the supply may be regulated without entering the building, a valuable feature in time of fire.

Forty fire hydrants, each with three or four independent gates, are located about the property on the same yard mains that supply the sprinkler system and are so placed as to make possible the complete surrounding of any one building by fire streams. Each hydrant is protected by a wooden house in which are stored hose play pipes, axes, lanterns, etc. The amount of hose varies per hydrant from 200 to 500 feet, depending upon the length of the line that the particular hydrant is likely to be called upon to furnish. There is, as well, 1,000 feet of hose on the carts in the fire station. This makes a total of about 6,000 feet of two and one-half-inch fire hose.

In the fire house adjoining the tower containing the sprinkler tanks are two 1,500-gallon Underwriters' fire pumps ready for instant duty. These pumps are each capable of throwing six good fire streams and draw their supply from the large reservoir mentioned above, pumping into the yard system, thus supplying both the sprinklers and the hydrants as needed.

There is available in the tower for the sprinkler system and hydrants 213,000 gallons of water, and as soon as the pumps are placed in operation an additional supply of 3,000 gallons per minute, so long as the 5,000,000-gallon reservoir holds out. Running both pumps full capacity the reservoir will last for twenty-seven hours.

All of the buildings are liberally equipped with water and sand pails for fire use, with chemical extinguishers and with small hose connected to the sprinkler system.



POWER PLANT, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

There is about 4,500 feet of this small hose distributed throughout the different buildings.

This elaborate and expensive system of fire protection would be of small value if trained men were not available for instant fire duty; therefore, the company maintains a fire brigade among its employés.

An ex-member of the Protective Department from the city of Chicago is the chief of the fire department, and devotes his time solely to the apparatus and the training of the brigade. Under him, during the day, sixteen men are employed in the departments near the fire house, who respond to all alarms. These men are picked for this special duty and are given extra compensation, including pay for drills as well as for fire service. At least twice a week a trial alarm is rung in, the department drilled with the use of the different apparatus, and familiarized with the surroundings and conditions that they would be likely to meet in time of fire. At night nine watchmen with a fire captain form a brigade; there being at least five of them at all hours of the night in the pump house where beds are provided for sleeping accommodations.

A system of forty-seven fire boxes has been installed, permitting prompt notification to the fire house, the members of the fire brigade, the engineer in charge of the fire pumps and the shop superintendent, so that immediately all of the trained force may be on duty. The average time taken to get sixteen men and two streams of water at any point of the property is less than two minutes after turning in the alarm.

INTERIOR OF MACHINE SHOP, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

ELECTRICAL EQUIPMENT.

The four generators located in the engine room are the Western Electric Company's "L" design, and have several features of especial interest. The pole-pieces are laminated, and the frame is cast around the assembled poles, a novel method of casting being employed. With a cast-in pole-piece trouble is usually experienced in securing a completed frame having equally spaced poles as the shrinkage strains are apt to distort the pole setting, resulting in unequal distances between the tips of the poles. To prevent this irregularity the poles of these machines are assembled in a heavy cast-iron clamp which is placed in the mould. The arrangement is such that the shrinkage strains are taken up in the yoke and do not distort the position of the pole-pieces, thus assuring uniform air-gap flux distribution, a condition necessary for satisfactory operation.

That part of the armature conductor lying outside of the armature core has an enlarged section, while that part lying inside of the core has a reduced section over that usually employed in machines of these sizes. By this means a shallow slot is obtained, thus reducing the reactance of the coils during commutation and producing conditions essential for sparkless range. The effect of the enlarged sections at the ends of the armature is to increase the radiating surface of the coil, and by reason of the high conductivity of copper

to draw from the armature core the accumulated heat, thus permitting of large overload capacities with a minimum temperature rise.

As the length of that part of the coil lying outside of the core is approximately sixty-six per cent of the total length, there may be obtained by reason of the enlarged section a minimum armature resistance, and consequently a maximum efficiency.

The main switchboard, located on the gallery in the engine room, consists of eighteen 30 × 78-inch marble panels placed fifteen feet above the floor. The four generator panels each have a circuit-breaker, ammeter, rheostat and two single-pole switches. There is mounted on a separate panel a station ammeter, recording wattmeter and recording voltmeter. The remaining panels feed the different sections of the plant, each panel controlling two departments. Each department feeder has its own ammeter, recording wattmeter and circuit-breaker. By this system a record is kept of the amount of power required for each department. The main station voltmeter is common to all circuits.

As the generators operate at 230 volts, the main switchboard is so arranged that the two smaller units may be operated in series so that 550 volts may be available for testing purposes, the shunt field coils being of sufficient capacity to permit of an increase in the terminal voltage of the machines.

The various buildings are connected with the power-house by a system of well-lighted and ventilated tunnels, in which are located the telephone, lighting and power cables, and pipes for the drinking, city and house water, compressed air, live and exhaust steam, vacuum and trap returns, roof drain and hydraulic elevators. These tunnels have a uniform height of seven feet and vary in width from four to ten feet.

Connecting with the tunnel leading to the machine shop is a system of concrete trenches surrounding the iron plates of the testing floor. Within these trenches are cables leading into junction points at which are available for testing purposes all voltages from thirty to 600 volts, both direct current and alternating current of twenty-five to sixty cycles.

The yard and building illumination consists of arc lamps, two in series on 220 volts, and incandescent lamps for local lighting.

All of the machinery in the entire plant is electrically driven, an individual drive system being employed except in a few cases. The main machine shop and cable plant contains many variable speed motors which are operated from a three-wire system. A compensator, or voltage balancer, located in each of these buildings, is of sufficient capacity to carry the unbalanced load resulting from the variable-speed motor load.

The voltage balancer consists of two 115-volt machines connected in series directly across the mains, with the neutral wire connected between them. The machines are compound wound, the series fields being connected in the neutral wire.

There are several interesting examples of individual machine drive. The forge shop is equipped with electrically driven cold saw, shears, bull-dozers, blowers for forges and two cutting off machines. One of these is equipped with a one and one-half-horse-power 4 to 1 variable-speed motor, operating on a three-wire system.

In the machine shop will be found an E. W. Bliss No. 5 press, driven by a five-horse-power, 1,000-revolutions-per-minute motor, mounted on top of the press frame and direct geared to the machine through an internal gear on the flywheel, which meshes with a pinion on the motor.

An interesting example is a Ferracute Machine Company's punch press used for slotting large armature discs. It is driven by a protected type three-quarters-horse-power variable-speed motor belted to the flywheel of the machine.

There are also several sheet-iron shears found in the machine shop. The driving motor is of the protected type, delivering two horse-power at 1,850 revolutions per minute. It is mounted in an inverted position on the under side of the machine table, and is direct-geared through a rawhide back gear to the main driving shaft of the machine. One of the standard starting panels used for these machines may be seen at the right hand of the photograph.

Motor drive is again illustrated by a Springfield surface grinder, the main motor of which is a two-horse-power at 850 revolutions per minute. It has a pulley at each end, and both of these pulleys are belted to the spindle of the grinding wheel. The motor is mounted on the grinder head and travels with it across the work. On about the same level with the main motor, behind the housings, may be seen an auxiliary motor mounted on a bracket and direct-geared, through an internal gear, to the shaft which carries the open and cross bolts for the reversible bed travel of the machine.

An example of a small machine, individually driven, is a Pratt & Whitney surface grinder, with a six-inch grinding wheel, direct coupled by means of a flexible coupling to a one-half-horse-power motor at 2,600 revolutions per minute.

FOUNDRY, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

Among the large machine tools located in the machine shop may be mentioned a Dietrich & Harvey open-side planer 120 inches by 24 feet, driven by a forty-horse-power, open-type motor at 950 revolutions per minute. The motor is mounted on a bracket on the housing, high enough to be out of the way, and is belted to a countershaft on the machine. There is also a three-horse-power motor on top of the housings, which serves to raise and lower the cross-head.

A large Niles' extension boring mill is also electrically driven. The main motor, rated at ten horse-power, is below the floor and drives the boring mill through spur-gearing. A small auxiliary motor of three horse-power capacity is mounted on the rear bed-frame of the machine and is geared to the traversing screws for rais-

ing and lowering the cross-heads and for traversing the housings.

Near this boring mill is a row of eight Gisholt turret lathes. Five-horse-power variable-speed motors are used in driving these machines. On the rear of the bed, below the head-stock, is a small auxiliary motor for traversing the turret.

Further on is a single-headed traverse shaper which is direct-geared to a protected type one and one-half horse-power 4 to 1 variable-speed motor. A considerable speed reduction is obtained by a back gear, which is within the gear case shown in the plate. A drum type controller is actuated by a cord passing twice around a drum on its shaft, and also around a drum on a splined shaft on top of the machine,

WATER-TOWER, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

which carries two hand wheels, one at the right-hand end of the machine and the other on the shaper carriage.

A Lodge & Shipley eighteen-inch lathe, direct-geared to a four-horse-power variable-speed motor is also of interest.

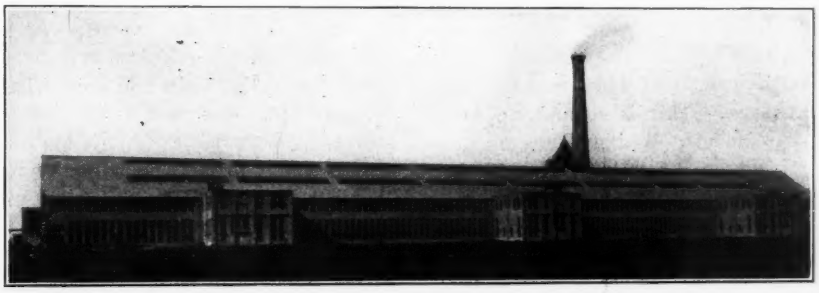
Numerous electric grinders used in the foundry, machine shop and forge shop are all motor-driven.

Mounted inside of the pedestal of a Brown & Sharpe surface grinder is a motor with a belt passing around it to a set of counter-weighted pulleys on the grinder spindle. In this way the grinder may be raised or lowered to suit the height of work, while maintaining the proper belt tension for all positions.

Among the portable machines is noticed a large boring and drilling machine, manufactured by the Newton Machine Tool Works. The machine is entirely self-contained, being provided with an arc lamp as well as motors for power. It has two heavy stirrups, one at each side of the frame near the top, so that it may be easily picked up and carried about by the traveling crane.

In the insulating department of the cable plant are located eighty special insulating machines, each having five heads operating simultaneously to insulate five wires. The arrangement is such that two machines are driven by one motor, a eight and one-half-horse-power variable speed, operated by a specially designed controller.

After the wires are insulated they are twisted together in pairs by the twisting machines. The driving motors are of the encased type, one horse-power at 1,300 revolutions per minute, and operate the twisters through spiral gears. On the end of each machine frame, above the motor, is a solenoid self-starter which is operated from two push-buttons, one for starting and the other for stopping the motor. The operators thus have the machines under instant control.



MACHINE SHOP, HAWTHORNE WORKS, WESTERN ELECTRIC COMPANY.

In the room adjoining that containing the twisters are located the cable-twisting machines. The largest one of these machines will carry nearly 600 spools of twisted pairs of wires. This machine is belted through a line shaft to a motor of thirty horse-power, 625 revolutions per minute capacity. Each of the large rotating reels, which carry a number of wire bobbins, is separately belted to the line shaft by means of a cone pulley on the machine and another on the line shaft.

In the lead-covering department there are several thirty-horse-power slow-speed motors, each direct-connected to the crank shaft of a high-pressure pump operating a hydraulic press used in the process of covering the cables with lead casing.

The lead-covered cable, as it is delivered by the presses, is wound upon large wooden reels for shipment. Each reel is driven by the contact due to its own weight upon a pair of motor-driven parallel rollers, whose upper surfaces are on a level with the floor. The motor which drives these rollers is below the floor and operates the rollers through a worm gear. It is controlled by a special mechanism operated by push-buttons held by the operator while directing the cable. The special mechanism consists primarily of a one-twelfth-horse-power reversible motor, the extended armature shaft of which is threaded, and drives a controller contact over the segments of a controller.

There is a small machine shop in the cable plant where the special machinery is built and repaired. The machine tools in this shop are motor-driven, the larger ones individually.

The wood-working machines in the pattern shop are driven individually by electric motors, which are encased in square wooden boxes, protecting the motors from dust and shavings. An exception to this general plan is a motor hung in an inverted position from the ceiling driving line and countershafts, to which are belted wooden turning lathes, grindstones, disc and emery grinders, sticker and planer-knife grinding machines. All the motors, with one or two exceptions, are provided with Cutler-Hammer self-starters, mounted in an asbestos-lined case with glass doors. The automatic starter is connected by a snap-switch in the most accessible place that can be found for it on the machine.

The rubber plant has several examples of large machines electrically driven. In the department where the crude rubber is washed there are a number of calenders, each geared to a twenty-horse-power 670-revolutions-per-minute motor, also several dust grinders, geared to a shaft under the floor, which is connected through a spur gear to a 200-horse-power motor, located in a pit of sufficient depth to permit this connection by a single reduction.

In an adjoining room a 200-horse-power motor located below the floor drives through positive gearing five rubber grinders, each of which may be thrown in or out of service by means of a large clutch. A smaller grinder is individually driven by a fifty-horse-power, 600-revolutions-per-minute motor through a rawhide pinion and double reduction.—*H. R. King, before the Western Society of Engineers.*

Reviews of Current Engineering and Scientific Literature.

Transmission of Energy at 36,000 Volts.

A description is given here by M. S. Herzog, of the hydroelectric station at Cellina, Italy, from which energy is transmitted to Venice. The station is on the Cellina river, a mountain torrent, and utilizes a fall of about 175 feet. The total available hydraulic power is 15,000, and it is anticipated that about two-thirds of this can be delivered to the city. A dam has been thrown across the river so as to raise the height of the water and to provide some regulation. From the dam a canal about 17,000 feet in length conducts the water to a point where the pipe lines begin. The turbines are of the Francis type, and are direct-connected to the alternators. They are rated at 2,640 horsepower and revolve at 315 revolutions per minute. At the present time there are six of these units. As the station is a little over fifty miles from Venice the fairly-high transmission pressure of 36,000 volts has been adopted. The generators themselves deliver from 4,000 to 4,800 volts, three-phase. This is stepped up to the pressure named. Within Venice the pressure is lowered to 6,000 volts for local distribution. There are a number of transformer substations, each feeding certain sections of the city, at which the pressure is still further reduced.—*Translated and abstracted from L'Électricien (Paris), May 5.*

A 100-Ton Electric Derrick Crane.

A short description is given here of a large electrically operated crane which has been installed at the plant of the Scotts' Building and Engineering Company, Greenock, Scotland. This crane is of the derrick type and is designed for a normal maximum lift of 100 tons at a radius of seventy feet. This type of crane was selected because it enables the centre to be placed extremely close to the edge of the quay. In this case it is only seven feet from the edge, enabling the crane to work with a load of 100 tons at an effective outreach of sixty-three feet from the edge of the quay. The crane is mounted on three pedestals which give clearance for the sides of the vessel and for tracks along the quay. The crane lifts 100 tons at any radius between seventy and twenty-five feet, ninety tons at seventy-five feet, eighty tons at eighty feet, sixty tons at ninety feet. There is an independent light gearing which lifts ten tons at any radius up to 100 feet. The maximum load is raised at five feet per minute; loads under fifty tons at ten feet per minute; under ten tons at forty feet per minute. The speed of slewing with full load is 100 feet per minute. The crane is operated by four motors. A fifty-horse-power motor running at 290 revolutions is used for derricking the jib; a fifty-horse-power motor for the main purchase hoist; a thirty-five-horse-power motor for light hoisting, and a thirty-five-horse-power motor for slewing. All these motors are operated independently by the driver, who is placed in a cabin on the side of the mast. Each motor is fitted with an automatic electric brake as well as a hand brake.—*Abstracted from Engineering (London), April 27.*

The Advantages of Employing Electrical Nomenclature in Steam Engineering Calculations.

A great deal of labor may be saved, Mr. H. M. Hobart thinks, in carrying out steam-engineering calculations, if electrical engineering units and nomenclature be employed. Fortunately for this purpose, it happens that the metric ton corresponds closely to the English long ton, so that but little confusion is caused when changing over from one to the other. It is allowable, therefore, to adopt the ton as the standard of weight, and to divide this into 1,000 parts. Since, in the English system, there is no term for the one-thousandth part of a ton, the author adopts the French term, which is, of course, the kilogramme. Adopting, then, the electrical unit of energy the calorific values of coal of different kinds are given and tables are compiled which show the various boiler efficiencies and coal qualities and the tons of steam raised per ton of coal burned as a function of the boiler pressure and superheat. They also show the cost of coal in tons per kilowatt-hour for various boiler efficiencies and prices of coal. Another table shows the energy in kilowatt-hours contained in one ton of steam, and the energy in kilowatt-hours necessary to raise a ton of steam at constant pressure. From these tables it is a simple matter to compute at once the thermal efficiency of any generating station. For example, a certain generating station in England produced, during the past year, 1.5 million kilowatt-hours. It burned 6,700 tons of coal with a calorific value of 7,500 kilowatt-hours per ton; therefore the overall efficiency of the generating station, which is obtained at once, was three per cent. The author thinks that much advantage would accrue from the use of similar tables in all such work, and suggests that they be incorporated in the usual engineering handbooks.—*Abstracted from the Electrical Review (London), April 27 and May 4.*

Osmotic Pressure.

Attention is directed here by Lord Berkeley to the necessity for an agreement among physical chemists as to what is meant by the term "osmotic pressure." Duhem has defined osmotic pressure as the difference between the pressure on the solvent and the pressure applied to a solution to keep it in equilibrium with the solvent when the two are separated by a semi-permeable membrane. This pressure varies according to the pressure on the solvent, and Spens suggests using a definite pressure on the solvent, say its vapor pressure, as the standard. The author points out that by accepting this definition one is necessarily bound to compare two solutions when they are under different conditions, not only on account of the different vapor pressures of different solvents, but on account of the different pressures on the solutions themselves. There seem to be two methods of examining directly the osmotic pressure of a solution. One, called the osmotic force method, depends essentially on the determination of the rate at which the solvent will flow through a semi-permeable membrane into an infinite mass of solution when there is no pressure on the latter. If the frictional resistance to flow were known, it would be easy to calculate osmotic force in absolute units. Unfortunately, this is not possible. Other methods give what may be called equilibrium pressures, and depend upon the measurement of the pressure necessary to bring about a balance between the solution and the solvent. These equilibrium pressures can not, on account of the compression of the solution, be measured under the same conditions. The author suggests that until some way has been devised for measuring the osmotic force itself, that the relation between the vapor and osmotic pressures of a solution which has been deduced by himself and Mr. Hartley may be useful for the purpose of comparing the osmotic pressures of different solutions. This relation gives the osmotic pressure of a solution when it is under no pressure but its own vapor pressure. A knowledge of the vapor pressure, together

with the density of the solvent, is all that is required for calculating the pressure. To apply the standard proposed by Spens makes it necessary to determine the increment in volume of the solution when unit mass of solvent enters it; and in some cases it may be necessary to obtain the coefficient of compression of the solution. The experimental work saved by the adoption of the standard here proposed is great, particularly since, owing to the want of semi-permeable membranes, the measurement of equilibrium pressures is confined to but a few substances dissolved in water. —*Abstracted from Nature (London), May 3.*

The Hydroelectric Station on the Sioule River, France.

A hydroelectric plant has recently been installed on the Sioule river, France, for transmitting energy to Clermont-Ferrand, a distance of about twenty-seven miles from the power-house. The Sioule river is subject to frequent floods, so that the flow of water often rises quickly to about 100,000 cubic feet per minute. The average flow is 10,000 cubic feet a minute. The station has been placed on the right bank of the river. A dam has been erected to control the flow of water to some degree, and to provide storage capacity. The height of the fall is about eighty feet. The turbines are of the Francis type, placed horizontally. Each is direct-connected to an 800-kilowatt generator. There are four of these units, though provision has been made for adding two more. These deliver three-phase currents at 1,000 volts, fifty cycles per second. By means of groups of single-phase transformers the voltage is stepped up to 22,000 volts for transmission. The transformers, switchboard and lightning arresters are placed in a wing of the main power-house. This building is three stories in height, the transformers being on the lower floor, the switchboards on the second and the line protectors on the third. The latter are of the Wurts type, consisting of a number of small gaps connected in series. The transmitting system consists of a single main line connecting the generating station with the principal substation at Clermont. The distance is about twenty miles. A double line has been put up, each consisting of three wires. From the substation at Clermont one branch line runs to Mozac, another to Pont-du-Chateau. There are also a number of branches running out from the various substations at the intermediate voltage of 3,000. The line has been constructed on the modern system, following American practice. Steel poles are used, spaced 300 feet apart, on which the wires are carried by means of porcelain insulators. Each substation contains two groups of three single-phase transformers rated at 375 kilowatts. These deliver current for local distribution at 3,000 volts. Provision is made at the substations for separating the power and light lines and supplying each from separate bus-bars by means of independent transformer groups. The substation at Clermont-Ferrand contains, as a reserve, a steam unit to supply Clermont and Royat with current should the transmission line fail. The price for power varies from twelve cents per kilowatt-hour for small quantities to four cents for larger amounts. For power purposes it varies from three cents per kilowatt-hour to one cent, according to the amount used. —*Translated and abstracted from La Revue Électrique (Paris), April 15.*

The Electrical Equipment of a Mexican Mine.

In an interesting article entitled "Mining and Metallurgy in El Oro, Mexico," Mr. H. E. West describes in detail the features of this gold and silver mining camp and the method of extracting the metals from the ore. A noteworthy feature of this camp is the use of electrical power almost to the exclusion of steam power. This transition has been made recently, and it has already effected a very considerable saving in the cost of operating the mine. The power is supplied to the mining camp by the Mexican Light and Power Company from its generating station at Necaxa, about 170 miles from the camp, at approximately $50 gold per horse-power-year. The current is delivered at El Oro through two separate circuits of three wires each, the three-phase, alternating system being employed. At present the voltage is 40,000, with a provision for raising it to 60,000 volts later. About 10,000 horse-power is allowed for the El Oro camp, of which the Dos Estrellas mine will take about 4,000, and the El Oro and Esperanza mines about 3,000 each. At the company's substation the voltage is reduced to 3,000 for distribution to the several customers. On the El Oro property synchronous motors about thirteen feet in diameter are employed. These take current at 3,000 volts, sixty cycles, and run at eighty-nine revolutions per minute. They are employed for driving the stamp mill and the cyanide plant, the former taking about 550 horse-power and the latter 250. In addition to the 100 head of stamps in the mill this motor drives also three Krupp tube mills, which together take more power than the stamps. The constant speed of these motors has been of marked benefit in the stamp mill, as it is important that there shall be no variation in speed in the driving of the cams. The cyanide plant motor at present drives the agitators, pumps, belts and other apparatus through a series of rope drives. This has proved inefficient and wasteful, and is now being split up into separate motor drives. Synchronous motors are being applied also to the compressors, which are equipped with an intake choking controller device. The motor and the compressor are thus driven at a constant speed. The most interesting innovation at the mine has been the installation of electric hoists. There are for this purpose two 200-horse-power motor-generator sets. These are apparently operated on the Ilgner system, although this is not so stated. An alternating-current motor drives on the same shaft a direct-current generator and a heavy flywheel. The hoist is operated by a direct-current motor. The horse-power constantly used in turning over the motor-generator set is about thirty-two, while the peak load at starting is about 550. On some of the smaller hoists variable-speed, alternating-current motors are operated successfully. The starting torque is from two to three times the normal. In braking these motors no power is saved, while with the other system of hoisting the motor returns power to the line. It is said that in February the electrical equipment effected a saving of $20,000, which is considerable when taking into consideration the fact that this power is not as yet used exclusively. The amount of mining expense was reduced to $5.01 gold per ton of ore treated instead of $6, as was the case for the previous month. This saving is due largely to the economy of the new system. The old steam plant required about 200 cords of wood per day, to handle which necessitated a number of steam locomotives and a large number of hands. The cost of the steam produced in the old plant was about five cents, silver, per horse-power-hour. Within a short time all the motive power in this mine will be electrical, with the possible exception of the fire pumps. Four-step centrifugal motor-driven pumps are now being installed for lifting water and pumping the cyanide solution. There is also a triple-throw motor-driven pump having a direct lift of 1,200 feet. The Dos Estrellas mine of the same camp will soon have an equipment which will be, in some respects, superior to that of the El Oro. The output of these three mines is about $900,000 gold per month.—*Abstracted from the Mining Magazine (New York), May.*

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

The accompanying illustrations show some of the newspaper advertising which has recently been done by the Grand Rapids Edison Company, Grand Rapids, Mich. Here again is demonstrated the value of conforming to a definite style of display and utilizing plenty of white space around the printed announcement. In each case the type display has been surrounded by fully an inch of white space. The Grand Rapids company has been very successful in its newspaper advertising, and believes in making frequent changes in its announcements, making its statement in a very few words and calling direct attention to some specific use for electric lighting in each advertisement.

In addition to its newspaper advertising the company recently made a special canvass on "Hylo" lamps, introducing a large number of these special devices into the homes in its territory. A special canvass has also been made with regard to placing the electric flat-iron in service. Within a very short time over 300 irons, mostly of the six-pound size of the General Electric make, were put out. These

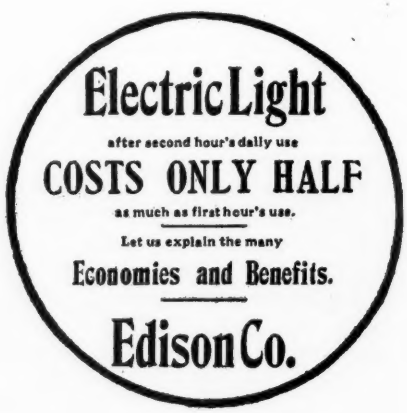
irons were placed on a thirty-day free trial, and the company is confident that but a very small percentage will be returned. These irons are giving splendid satisfaction, and will not only be a means of popularizing the electric service, but will also be a source of revenue. The current sold

during the time that these flat-irons and other heating devices are used is taken from what the company calls its "valley" load, and is more desirable business than that which comes onto the peak load.

The company has also made an elaborate exhibit at a pure food show, held in the Auditorium Hall, Grand Rapids. At this exhibit a demonstration was made with many forms of electric heating devices,

showing the application of these devices to all forms of domestic service.

The company is inaugurating a system of direct-by-mail advertising, which consists in sending out a certain number of bulletins each month, together with mailing cards, booklets and letters. This advertising matter, it is believed, will be the means of bringing enquiries, so that the company's soliciting department can follow them up more rapidly and make a special effort to acquire considerable new business. A monthly bulletin is also being distributed, calling attention to special



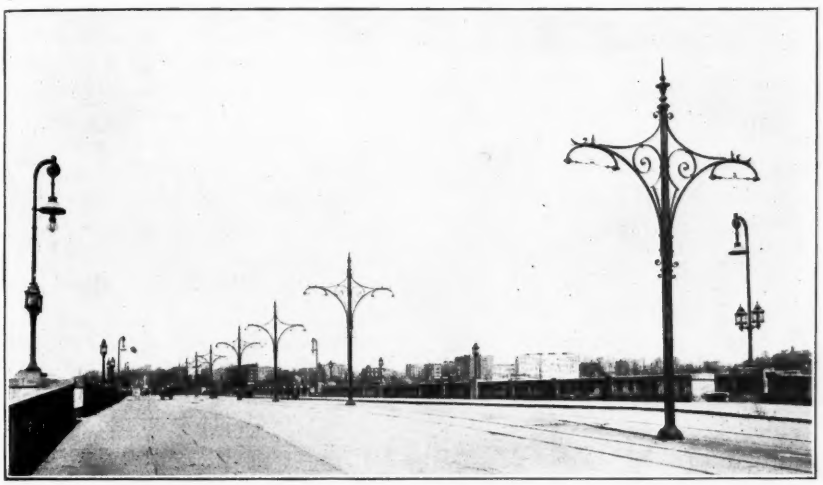
applications of electricity and describing installations where central station service is meeting with very great success.

INDUSTRIAL SECTION.

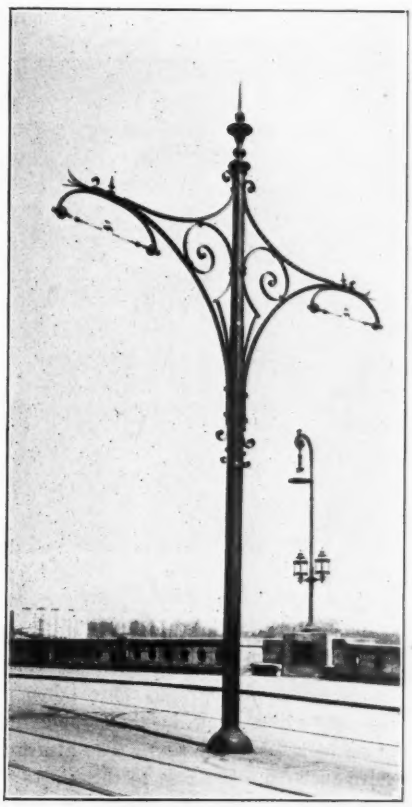
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Electric Railway Line Material.

The accompanying illustrations show some of the new electric railway line material designed and constructed by the Elmer P. Morris Company, 51 Dey street, New York city. The ornamental brackets shown herewith are being made for the Rapid Transit Subway Construction Company, and are installed on Washington bridge, New York city. The poles on which these brackets are installed were furnished by the Electric Railway Equipment Company, of Cincinnati, Ohio, for whom the Elmer P. Morris Company is the eastern agent.



LINE OF ORNAMENTAL DOUBLE-BRACKET POSTS, WASHINGTON BRIDGE.



ORNAMENTAL DOUBLE-BRACKET POSTS, WASHINGTON BRIDGE.

During the early spring the Oneida Railway Company, Utica, N. Y., placed an order with the Elmer P. Morris Company for the design and construction of poles to be used over the West Shore Railway between Utica and Syracuse. In conjunction with the Electric Railway Equipment Company, of Cincinnati, and Messrs. Rockwell & Bruce, engineers, New York city, a full line of devices was designed and constructed to meet these conditions.

Fig. 1 shows a pole with bracket arm and containing E. P. Morris's patented method of suspension of the messenger wire, with the secondary insulator on the cross-arm. The span shown in Fig. 1 is 350 feet long.

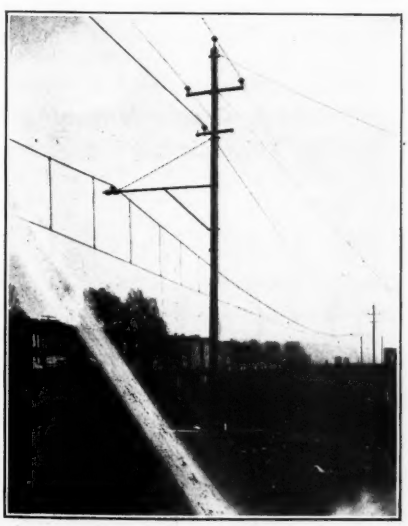


FIG. 1.—POLE TEST.

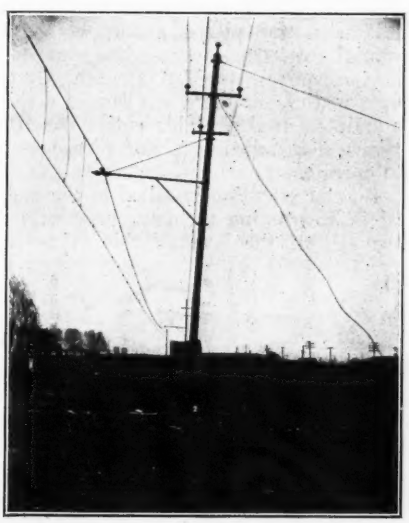


FIG. 2.—POLE TEST.

Fig. 2 shows one of these poles deflected at the top by pulling off on the span wire to a Miller anchor 125 feet from the base of the pole. A strain of 2,050 pounds put on this pole did not bend it in any manner. The pole was set seven feet in the ground with a concrete base twenty-four

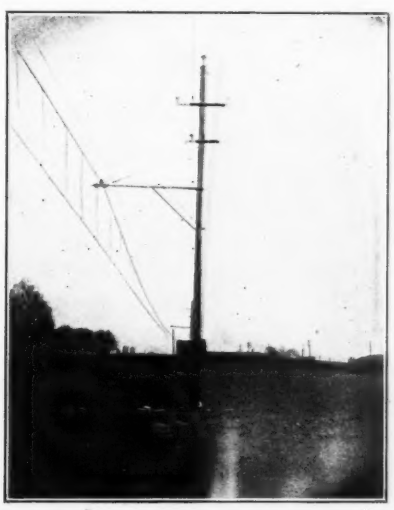


FIG. 3.—POLE TEST.

inches in diameter. The concrete base shifted in the ground, allowing the top to be thrown out of line. Fig. 3 shows the pole before the strain was put on and afterward, the two photographs being taken on the same negative. Fig. 4 shows

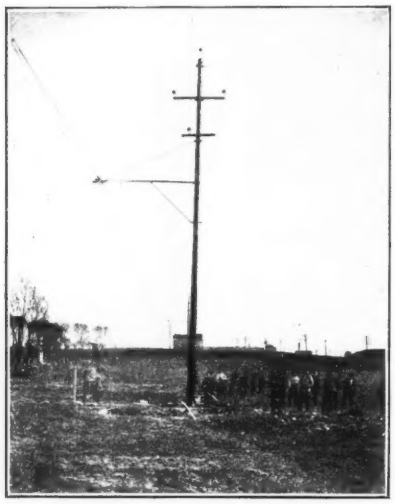


FIG. 4.—POLE TEST.

the strain being put on the end of the bracket arm. This amounted to 2,000 pounds. Two photographs were taken of this test, which show in the double line the slight bend in the arm. The arm was twelve feet from the pole to the centre of the wire.

Fig. 5 shows the linemen cutting the trolley wire in the 350-foot section, show-

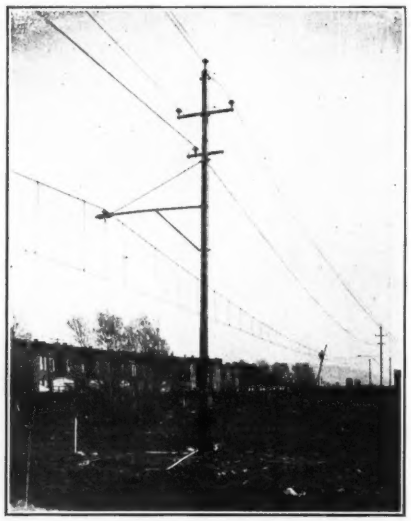


FIG 5.—POLE TEST.

ing a slight bend in the wire after it has been cut.

This demonstrates the safety of this form of catenary construction.

Fig. 6 shows the lines after cutting the catenary and trolley at one of the anchor lines, demonstrating that not more than one section would drop to earth at any time.

This exhibition was installed in the yards of the Reading Iron Company, Reading, Pa., and consisted of three iron poles forty-seven feet overall, made of a ten-inch, nine-inch and eight-inch pipe. Three of these poles were set and equipped with brackets, the first section being 300 feet long, the second section 350 feet long, anchor pulleys set 100 feet meeting each end, making the total length of the catenary construction 850 feet. Upon the poles there were placed four-point, pressed-steel cross-arms of the company's standard make. These cross-arms carried one 500,-

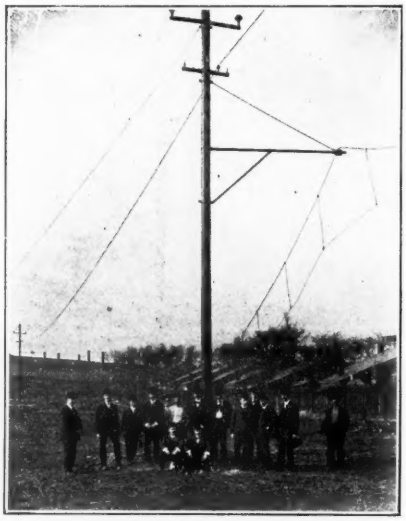


FIG. 6.—POLE TEST.

000-circular-mil, bare feeder wire. Above this wire was placed a forty-eight-inch special cross-arm carrying two aluminum feeders equivalent to 2/0 capacity. On the apex of the pole there was carried a third aluminum feeder. This entire construction was installed as if for a road ready to operate.

Special attention is called to the method of suspending the messenger wire on the end of the bracket, this being carried on a high-tension insulator tested for 85,000 volts. Directly underneath this were placed, one on each side, a secondary insulator which would catch the messenger in case the main insulator should break, thus preventing any possible chance of a short-circuit. This special feature has been patented.

Lead Seal Presses.

The H. C. K. Company, 45 Broadway, New York city, is manufacturing a new style of lead seal press and lead seals with wires for electric and gas meters, service boxes, fare register, freight and baggage

LEAD SEAL PRESS.

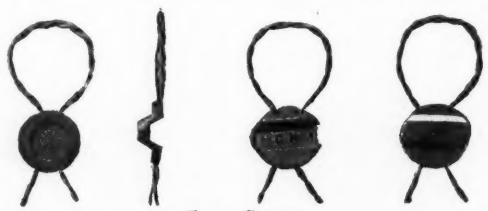
cars. An important feature of this press is that it fastens the lead seal to the wire in such a way that it is impossible to open the seal without cutting the wire. The zig-zag-shaped dies in the press form the lead seal, as shown in the accompanying illustration. The initials of the owner of the press can be sunk in the lower die. When several presses are required by one company, they are usually numbered consecutively, and the number of figure is sunk in the upper die of the press. The initials and numbers will appear in relief on each seal which has been closed by this press.

Central station and railway companies have found it advantageous to number each press which is for use by one employé only. This employé is held responsible for his press and for seals bearing his identification number. The importance of this system of meter sealing will be appreciated by superintendents and managers, who may otherwise have difficulty in locating the employé who last applied the seal.

The press is constructed of malleable iron and the dies are made of tempered steel.

Arizona Copper Merger.

A merger to include four large Arizona copper mines, controlled by Calumet, Duluth and Pittsburg capitalists, has been formally announced from the main office



LEAD SEALS.

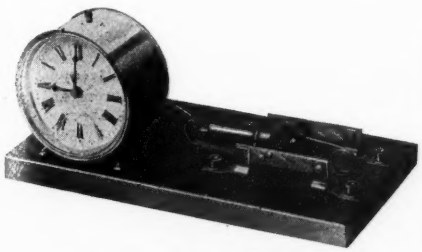
of the companies in Calumet, Mich., by a circular letter sent to stockholders.

It is proposed to organize a new corporation with $20,000,000 capital to take over the Calumet and Pittsburg, Lake Superior and Pittsburg, Junction and Pittsburg and Duluth mining companies

operating at Bisbee, Ariz. These concerns are controlled by Charles Briggs, James and Thomas Hoatson, of Calumet, and Thomas F. Cole and associates, of Duluth. The deal will result in one of the most important copper mining corporations in the world.

An Automatic Time Switch.

The accompanying illustration shows an automatic time-switch which has been placed upon the market by the Specialty Manufacturing Company, Youngstown, Ohio. The time-switch is mounted on an enameled slate base. The switch is of approved design, properly spaced and nicely finished. The quick break spring



AUTOMATIC TIME SWITCH.

works very quickly and the manufacturer claims that arcing is impossible. The tripping device, which is operated by the clock, is automatically brought into position in closing the switch, requiring no caution in setting. The apparatus is easily installed and operated, and is said to be constructed strictly in accordance with the underwriters' rules.

Rochester-Lockport Road to be Built.

Arrangements have been completed whereby J. G. White & Company, of New York, will build a high-grade interurban line between Rochester and Lockport, generally paralleling the lines of the New York Central Railroad. The contract calls for an expenditure of $2,000,000, and the syndicate behind the project is represented by Frederic Nichols, E. R. Wood and Sir Henry M. Pellatt, all of Toronto, who are connected also with the Ontario Power Company.

Under the terms of the contract J. G. White & Company will grade fifty-four miles for double-track road, though only a single track will be laid at first, the second track being added when the traffic warrants further expenditures. The contract includes also all the overhead work, the building of five substations, with the electrical equipment, the building of repair shops and car barns and the supply of all rolling stock. The track construction will be heavy and the gradients will be so restricted as to permit the maintenance of high speed. The rolling stock will be of the standard design for interurban service and will include express cars, passenger cars and snow plows. Power will be supplied by the Ontario Power Company at 60,000 volts pressure, which will be reduced to the standard working pressure for direct-current railway service. The transmission line is the only portion of the electrical equipment which is not included in the contract, that being provided by the Ontario Power Company to the substations. The bridge structures, of which there will be a considerable number, will be of steel and concrete. There will be no grade crossings.

From Rochester west to Brockport, a distance of sixteen miles, including the towns of Spencerport and Adams Basin, the electric road will exactly parallel the main line of the New York Central on the north side. About two and one-half miles west of Rochester the lines of the Buffalo, Rochester & Pittsburg will be bridged, and again three-quarters of a mile further west there will be a bridge over the barge canal. From this point westward for a distance of over forty miles the electric road will lie between the barge canal and the tracks of the Central. At Holley, four and one-half miles west of Brockport, there will be a bridge over Sandy creek. A short distance west of Holley there will be a deviation of about three-quarters of a mile from the tracks of the Central, but the gap is closed again before reaching Albion, nine miles further west. West of Albion the tracks of the Central break slightly to the southward and proceed direct through Medina; the electric road will run almost due west for six miles, to include the town of Knowlesville, which is only a mile north of the Central tracks. From Knowlesville the direction of the interurban will be slightly more southerly into Medina. The main construction offices of J. G. White & Company will be established at Medina. The right of way of the interurban will be adjacent to that of the New York Central for seven miles west of Medina, passing through the town of Middleport; two miles west of Middleport the electric road will cross the tracks of the Central at a small angle on a long bridge. This is the only crossing of the Central tracks and from this point west into Lockport, a distance of nine miles, the interurban lies to the south of the route of the Central. Work will be commenced immediately.

Blast Furnace Gas Engine Development in the Pittsburg District.

The Carnegie Steel Company has contracted with the Westinghouse Machine Company, Pittsburg, Pa., for several large blowing engines to be driven by blast-furnace gas. For the purpose of conducting preliminary experimental work, a 350-horse-power engine, running at 150 revolutions per minute, with a thirty-inch stroke, was installed. This engine has made a remarkable record for itself under severe tests for efficiency, reliability and durability. Two gas-blowing engines, the largest ever built in this territory, are now under construction at East Pittsburg for the work at the Edgar-Thompson furnaces at Bessemer. These will be twin tandem units with Slick air-blowing "tubs," arranged in front of a *vis-a-vis*, and with a flywheel interposed between the two sides of the engine. Each of these blowing units will have a capacity of 25,000 cubic feet of free air per minute, operating against a normal blast pressure of eighteen pounds. The engines are run at a speed of sixty to seventy-five revolutions per minute. When higher pressure is demanded, the valve gear of the engine may be so altered as to deliver air under pressures up to twenty-five pounds per square inch.

Engineering on the Pacific Coast.

The announcement is made of the incorporation of the engineering firm of W. S. Barstow & Company, with offices at 56 Pine street, New York city, and Failing Building, Portland, Ore. Mr. Barstow, who has in recent years been closely identified with transmission work on the Pacific coast, has secured the cooperation in the new company of J. B. Taylor, late with Westinghouse, Church, Kerr & Company, and R. L. Donald, late with the Southern Pacific Railroad. They will undertake the complete designing and construction of electric lighting, railway and power plants and distributing systems; the designing and construction of industrial plants; supervision and management of electrical properties; special reports and examinations on operation, improvement and extension of existing installations. Within the last week it has booked orders for seven important installations running into the millions of dollars; Mr. Barstow, who was at one time prominent in the electric lighting field and manager of the Edison system in Brooklyn, is at present president of the New York Electrical Society.

The New Hamburg-American Liner.

The Hamburg-American line's new steamship, Kaiserin Auguste Victoria, arrived in New York on Saturday, May 19. This is said to be the largest steamship ever built, and was constructed at the yards of the Vulcan Shipbuilding Company, Stettin, Germany. The ship was launched on August 29, 1905. She is 900 feet in length overall, with a beam of seventy-seven feet and a depth from the boat deck to the keel of eighty-seven feet. Her gross tonnage is about 25,500 tons and her displacement at full load is 45,000 tons.

The ship has a number of features of luxurious character, including a palm garden, an à la carte restaurant, electric elevators connecting the decks and a dark room for photographers.

All the living rooms, as well as the engine and boiler rooms and the provision and store rooms, are electrically lighted with over 4,000 incandescent lamps. Current is generated by six dynamos, five of which are in the engine room and one above the water line between the boiler and engine rooms. In addition to the lighting equipment there is a bell-signal system for all the saloons and the rooms of the first and second cabins, the rooms of the ship's officers and the pantry. There are electric cigar lighters in the smoking rooms of the first and second cabins and in the restaurant. There are electric curling irons in the first and second cabin staterooms. There is an alarm bell-signal system for the ship and engines, bell-signal system for fire-extinguishing purposes and a fire-alarm system with annunciators on every deck.

All apartments and staterooms, except the smoking room, are electrically heated. In the kitchen there are installed electrically operated plate washers, knife cleaners, silver-cleaning machines, egg boilers, coffee and tea machines and water filters.

A Marconi wireless-telegraph station is installed near the first-cabin smoking room on the sun deck, where telegrams are received and sent and news is to be received for two daily newspapers, which are printed on board, one in German and the other in English.

There is a loud-speaking telephone system connecting the bridge with both engine rooms, the engineer's office, the telephone house aft, the crow's-nest, the lower bridge, the wheel house and the stern. The ordinary telephone system connects all the passenger staterooms of the first cabin, as well as the saloons. There are six telephone central stations for the first cabin and one telephone central station for the second cabin.

The ship is driven by two four-bladed manganese bronze screws twenty-two feet in diameter. These are connected, by means of propeller shafts 217 feet long and 19.3 inches in diameter, with the two main engines, which have a normal speed of about eighty-four revolutions per minute and are of about 17,200 horse-power. The main engines are four-cylinder, quadruple-expansion, and are balanced to prevent vibration. Each main engine has a surface condenser of 11,160 feet of cooling surface for condensing the exhaust.

The boiler plant consists of eight double-ended and one single-ended cylindrical boilers with fifty-one furnaces in all. The former operate with forced draught while the single-ended boiler operates with natural draught and serves as an auxiliary boiler while in harbor. The steam pressure is 225 pounds. The forced draught is provided by two fan blowers, each having a diameter of eleven feet and being driven by a 100-horse-power steam engine supplying 1,130 cubic feet of air to the furnace grates. The necessary feed water is supplied to the boilers by three twin steam pumps on the Weir system, which are placed in the engine room and force the water through two filters to the feed-water heater, or direct into the boiler.

In order to make up for wasted feed water there are two evaporators, each of which has a capacity of twenty-five tons of fresh water per twenty-four hours.

The ventilation of the different boiler and engine rooms is effected by four fan ventilators, each of which is driven by a steam engine and is installed above the boiler room, supplying air through ducts. The ventilation of the engine room is also effected by means of ventilating pipes leading down from the deck.

The American Street and Interurban Railway Engineering Association.

Mr. H. H. Adams, president, and S. W. Mower, secretary and treasurer, of the American Street and Interurban Railway Engineering Association, have sent the following letter to the members of the American Railway Mechanical and Electrical Association. This letter explains, in part, the newly adopted constitution and by-laws of the association, which is now affiliated with the American Street and Interurban Railway Association. Each member of the American Railway Mechanical and Electrical Association has been invited to join the new engineering association. Under the rules formulated since the last convention of the American Street Railway Association, the parent body fosters the auxiliary societies and aims in many ways to strengthen these organizations.

We are pleased to hand you herewith the newly adopted constitution and by-laws of our association, now known as the American Street and Interurban Railway Engineering Association.

The draughting of this constitution, as you will remember, was entrusted to your executive committee at the Philadelphia convention in September, 1905. It has received the most careful thought and attention, not only of your committee, but also of the executive committee of American association, and as adopted and printed herewith, it has the approval of that body, with whose constitution and by-laws ours now conforms in every respect.

For your information a copy of the constitution and by-laws of the American Street and Interurban Railway Association is enclosed, and we would call your attention to the general plan and most radical changes of the reorganization.

EXECUTIVE COMMITTEE.

The general supervision of the work as a whole shall be vested in the executive committee of the American association, which shall consist of four representatives of that association, and the presidents of each of the affiliated organizations.

MEMBERS.

There shall be two classes of members in the American association, *viz.:* active (or company) and associate (or individual).

All active members of the American association shall also be active members of the affiliated associations, with the privilege of sending as many representatives to any of the conventions as they choose, one of whom will bear credentials authorizing him to vote.

Individuals making application for associate membership in the American association shall signify with which branch (if any) they wish to ally themselves. Those naming the engineering branch shall be the associate members of the engineering association.

All former members of the American Railway Mechanical and Electrical Association will be eligible to associate membership in the engineering branch of the American Street and Interurban Railway Association. Their relation to the engineering association shall be identically the same as it has been to the American Railway Mechanical and Electrical Association.

FINANCES.

No dues shall be paid into the treasuries of the affiliated organizations. Instead, company members will be assessed by the American association in accordance with a fixed scale, based on the annual gross receipts of the company; and associate members will pay dues of five dollars into the treasury of the American association.

The American association will apportion to the affiliated associations sums sufficient to conduct their work, the appropriation to the engineering association this year to be two thousand dollars.

OTHER BENEFITS.

The American association will also assist the affiliated associations in every way possible, and you can readily realize that under the new arrangement the work as a whole will be much more systematically conducted, and more definite results made possible.

ENGINEERING ASSOCIATION.

The organization of the engineering association remains unchanged. Our opportunities are greatly increased. Not only have we been permitted to retain our identity, but on the other hand, our conditions and possibilities have been bettered in every respect.

We therefore urge that the enthusiasm and interest with which you have worked in the past will continue, and that every one of our old members will enter into the work this year with renewed zeal, replying promptly to queries that may be addressed to you by any of our standing committees, endeavoring to secure new members for the engineering association, and exerting every effort to make our branch of the work successful.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

CANADIAN BELL TELEPHONE COMPANY TO INCREASE ITS CAPITAL—An interesting statement has been prepared by the Bell Telephone Company, of Canada, in applying to the Dominion parliament for permission to increase its capital stock from $10,000,000 to $50,000,000. The uses to which the new capital will be put are outlined as follows: subscribers and exchanges, $21,000,000; underground conduits, $33,000,000; long-distance service, $11,000,000. The capital investment by provinces is given as follows: Ontario, $5,500,000; Quebec, $4,500,000; Manitoba, $2,000,000; western provinces, $300,000.

UTAH LIGHT AND RAILWAY COMPANY TO BE SOLD—The principal holding of the Mormon church, the Utah Light and Railway Company, is to be taken over by a $25,000,000 corporation composed of English and American capitalists. Among the directors are: H. H. Vreeland, New York city; Baron d'Oissel, Paris; Sir Thomas Jackson, London; William G. Rathbon, Manchester, England; Alexander McKenzie, Ottawa, Canada; Henry Dupont, Paris; Beresford Hope, London, and a number of Utah men, including Governor John C. Cutler. The enterprise will be financed through the Intermountain Trust Company, recently incorporated in Utah and Idaho.

MICHIGAN STATE TELEPHONE COMPANY—The Michigan State Telephone Company, operating in the state of Michigan, has issued its second annual report. This is for the year ended December, 31, 1905. The gross earnings are $2,293,552; the operating expenses, $1,620,223; the interest on bonds and debt, $261,371; the special expenditures and bond disbursements, $15,397; preferred dividend, $137,100; old adjustments account, $69,363, leaving a surplus of $190,096. During the year $908,718 was expended for exchange and toll line construction and real estate. The number of stations at the end of the year was 77,047, an increase of 10,705 during the year.

POWER PLANT ON SNAKE RIVER—Dominicus J. Wilson, Boise, Ida., has filed a notice of appropriation of 8,000 cubic feet per second of the flow of Snake river for power purposes at Ox Bend, in Baker county, Ore. The plans have been filed in the name of the Snake County Power Company. It is purposed to construct a dam on the up-stream side of the bow, forty feet high, which will create a reservoir in the cañon extending back five miles. Across a narrow neck of land two or more tunnels will be bored from the dam to the river below. The effective fall for power purposes will be forty-eight feet. Each tunnel will be sixteen by sixteen feet, capable of carrying about 2,000 cubic feet of water per second. The available horse-power will be about 40,000. The site is well placed for the distribution of power, and is in the extreme northwest corner of Baker county, within easy distance of a number of mining camps, both on the Oregon and Idaho sides of the river.

WORK TO START ON THE BALTIMORE & HAGERSTOWN ROAD—Arrangements have been made by the Baltimore, Frederick & Hagerstown Electric Railway Company for the underwriting of $10,000,000 of its first mortgage five per cent bonds. The company has let a contract for the construction of its line from Frederick to Hagerstown to Westinghouse, Church, Kerr & Company, of New York. This firm will also have charge of the construction of the line from Frederick to Baltimore. Work on the Hagerstown section will probably be started within a few weeks. The route surveyed by the company is fifty-two miles long from Baltimore to Frederick, and twenty-six miles from Frederick to Hagerstown, making the entire line seventy-eight miles long. It is to be a single-track road with numerous sidings. In all about seven miles of sidings will be built. There will be two tunnels, one at Braddock Heights, about five miles from Frederick, which will be about 4,000 feet long, and the other at South Mountain, near Hagerstown, about 6,000 feet long.

ELECTRIC LIGHTING.

MILLVILLE, CAL.—Millville is now lighted by electricity.

DAVISBORO, GA.—T. J. Orr will install an electric light plant in Davisboro.

HARPER, KAN.—The new city electric light plant has been placed in operation.

INDEPENDENCE, KAN.—A. C. Stitch and associates will erect an electric lighting plant at a cost of $10,000.

PASADENA, CAL.—Pasadena has voted to issue $125,000 bonds for the installation of a municipal electric light plant.

SUFFOLK, VA.—The plant of the Suffolk Light and Ice Company has been sold to the Norfolk & Portsmouth Traction Company for $50,000.

LOOMIS, WASH.—The electric power and light plant of the Palmer Mountain Tunnel and Development Company, at Loomis, has been completed.

CLEVELAND, OHIO—The Lincoln Park management, headed by Charles L. Gill, has closed a contract for a $40,000 lighting plant to be installed in the new park.

BANGOR, ME.—The Kennebec Light and Heat Company, which supplies electricity for Augusta, Togus, Hallowell and Gardiner, is making extensive improvements.

WINONA, MINN.—The Minnesota Light and Power Company has been given a contract to install twenty street lamps at a cost of $50 per lamp per annum.

OGDEN, UTAH—A new power plant is being erected by the Utah Light and Railway Company and the Utah Construction Company jointly, one mile west of Devil's Gate.

AUGUSTA, GA.—The Anthony Shoal Power Company has been granted the privilege of extending its wires to Augusta. The plant is erected about fifty miles above Augusta, and will generate 18,000 horse-power.

PHILADELPHIA, PA.—New York capitalists have purchased the electric light plant of the White Clay Creek Supply Company, which lights Kennett, Avondale, West Grove, Londonberg and vicinity.

NIAGARA FALLS, N. Y.—The Niagara Falls Electrical Transmission Company has purchased a tract of land at the approach of the proposed trans-Niagara bridge. A transformer station will probably be erected at the point.

NEW HARTFORD, N. Y.—The New Hartford village board has granted a franchise to the Hudson River Electric Power Company to erect poles and string wires on the streets of the village for the purpose of furnishing light and power.

WILLIAMSPORT, MD.—Burgess John B. Fleming has appointed a committee of town officials and citizens to investigate the advisability of constructing an auxiliary plant to the municipal electric light works to be operated by water power.

CINCINNATI, OHIO—The directors of the Cincinnati Gas and Electric Company met recently and organized for the ensuing twelve months. Norman G. Kenan was reelected president, Theodore Clauss was made secretary-treasurer-auditor of the company.

WAYNESBORO, GA.—The Waynesboro city council has passed an ordinance calling for an election to be held on the proposition of bonding the city to the amount of $60,000 for the purpose of establishing waterworks and an electric light plant.

CORVALLIS, ORE.—The electric light plant will be shipped to Seaside, where it is to be reestablished. The Albany electric plant has acquired the right for lighting Corvallis. The transmission wires have a voltage of 2,200, while the voltage of the old plant was only 1,100. The Albany company expects to increase this

to 10,000 as soon as the necessary transformer and switchboard arrive, and will then be in a position to furnish electric power for manufacturing purposes.

GOSHEN, N. J.—Goshen's board of trustees has contracted with the Light and Power Company of that town to light the public streets for two years for the sum of $3,250 per annum. The contract calls for 137 incandescent lamps and twelve arc lights.

ALBANY, ORE.—With a view to supplying Lebanon with electric light and power from the Albany plant the Willamette Valley company is said to be negotiating for the purchase of the plant in that city. Power is transmitted ten miles to Corvallis from the plant at Albany.

MANASSAS, VA.—The question of bonding the town of Manassas in the sum of $50,000 for the purpose of providing electric lights, waterworks and street improvements was submitted to the freeholders of the corporation, and resulted in a vote of 79 to 13 in favor of the bond issue.

SPOKANE, WASH.—The Washington Water Power Company, of Spokane, is actively building its high-tension transmission line from Spokane into the Palouse country, and current for power and lighting purposes is expected to be available in June. A number of towns will be supplied.

BUFFALO, N. Y.—By a vote of six to two the Buffalo councilmen overrode Mayor Adam's veto and decided to contract with the Buffalo General Electric Company for street lighting at $56 per arc lamp, and for a maximum rate of nine cents per kilowatt-hour for light to private consumers.

BONNERS FERRY, IDA.—The electric power plants at Newport and Bonners Ferry, Ida., are to be united under the name of Northern Electric Light Company, which has been incorporated with a capital stock of $35,000. A. M. Winston and M. A. Folsom, of Spokane, are the incorporators and owners.

BIRMINGHAM, ALA.—The stockholders of the Etowah Light and Power Company met recently and the following officers were elected: A. Brown, president; J. R. Brown, vice-president and treasurer; E. L. Wilson, secretary and general manager. This company operates the electric light plant at Attalla.

MEMPHIS, MICH.—The Memphis council has granted a franchise to S. R. Lester, of Sandusky, for the erection and operation of an electric lighting plant and a system of waterworks. He is given the exclusive right of the streets and alleys of the village, for above purposes, for a period of thirty years.

NEWARK, N. J.—The Woodbourn Electric Light, Heat and Power Company, of Sussex borough, has elected its directors and officers, as follows: president, Charles A. Wilson; vice-president, C. H. Crisman; secretary and treasurer, A. W. Bedell; directors, C. A. Wilson, Charles Crisman, J. J. Stanton, A. W. Bedell, and Clarence T. Van Sickle.

MADISONVILLE, KY.—At a meeting of the city council of Madisonville a majority of votes were cast in favor of the city building and operating its own lighting plant. Heretofore a private corporation has supplied the electric lights with a night service only. The contract with an eastern electrical company contemplates the expenditure of $9,722.

ROCKVILLE, CT.—The Rockville Gas and Electric Company has completed the expenditure of $40,000 in the enlargement of its plant and the extension of its business. The company is now extending a line to Stafford Springs, where connections will be made with the Stafford Springs Electric Light Company, which is under the same ownership as the local concern.

STERLING, ILL.—The Pecatonica River Power Company, of Silver Creek township, has filed a trust mortgage in the office of the county recorder of Stephenson county for the sum of $50,000 in favor of the American Trust and Savings Bank, of Chicago. The mortgage covers all real estate and right of way, together with all incomes. The company will use the money for the purpose of improving its plant.

IONIA, MICH.—The Michigan Power Company, which has taken over the plant of the Piatt company, of Lansing, and which proposes to utilize all of the water power rights it has acquired on the Grand river, has petitioned the board of supervisors of Ionia county for permission to construct a dam across Grand river on section four, township of Danby, Ionia county, for the purpose of generating electricity for power and lighting purposes.

ASPEN, COL.—An enterprise requiring an initial outlay of $52,000 has been inaugurated by D. R. C. Brown, president of the Roaring Fork Electric Light and Power Company. He is arranging to build a large light and power plant a few miles below Aspen. The plant will harness the waters of Castle creek and the Roaring Fork, and a drop of 2,200 feet through a forty-inch pipe will generate sufficient power and light for all emergencies in Aspen and the villages between it and Carbondale.

ROCKAWAY, N. Y.—At an adjourned meeting of the mayor and council the committee appointed to ascertain the feeling of the property owners who have not signed the petition to bond the borough for an electric light plant rendered its report. It was that at least two-thirds of the real estate owners representing the balance of the taxable property not included in the petition expressed themselves in favor of the borough owning and operating an electric light plant. The committee recommended an election to decide the matter.

SYRACUSE, N. Y.—As the result of an agreement reached by Syracuse city administration officials and the Syracuse Lighting Company the price of street arc lamps and for electric lighting for public buildings during the time that the city has no contract with the company will be governed by any ruling the state commission of gas and electricity may make after the lighting enquiry. In the meantime the city will pay for arc lamps at the rate of $65 per year and for other electric lighting at the rate of five cents per kilowatt-hour.

STILLWATER, MINN.—Officers of the Western Gas and Investment Company, of Chicago, the company owning the Stillwater Gas and Electric Light Company and several other lighting plants in the northwest, have arranged for the construction of a new dam at Apple river, between the dam now owned by the company and a dam owned by the St. Paul Electric Light Company. The new dam will enable the company to supply 1,000 horse-power additional, which will be disposed of in Stillwater and St. Paul. Work on the dam will be pushed.

SALT LAKE CITY, UTAH—The Institute Electric Company, of Telluride, Col., has filed a copy of its articles of incorporation with the secretary of state. The object of the company is to manufacture and sell electric power and light, and the acquirement of water rights. There is $1,000,000 of non-assessable stock of the par value of $1 per share. The officers are: William Story, president; Charles Ruffner, vice-president; Albert L. Woodhouse, general manager; William L. Biersack, treasurer; E. C. Lackner, secretary. Albert L. Woodhouse, of Utah county, is designated as general agent of the company in Utah.

ALBANY, N. Y.—Steps to install a lighting plant for the capitol and state buildings have been taken by the trustees of public buildings, who have advertised for proposals for the appliances required in the construction of a plant. Bids are to be submitted to J. G. White & Company, of New York, who have furnished plans for the work. The specifications call for several engines and electric generators and for the alteration and repairing of the present apparatus. The state had a contract with the Albany Electric Illuminating Company, but this expired more than a year ago and was not renewed. The legislature then provided an appropriation of $60,000 for a state plant.

SPARTANBURG, S. C.—A majority of the capital stock of the Electric Power and Manufacturing Company has been transferred to a Pittsburg syndicate. The properties involved are Nesbitt's shoals in Spartanburg county; Gaston shoals, on Broad river, in Cherokee county, and Palmer's shoals in Cleveland county, N. C. The properties have been under the control of the Electric Power and Manufacturing Company, and are said to have cost that company something more than $60,000. The purchasing syndicate contemplates developing the water powers, and will place large powerhouses at each of the shoals. It will spend several hundred thousand dollars in the development and furnish power to various enterprises.

PERSONAL MENTION.

PROFESSOR A. GRAHAM BELL has just received the degree of Doctor of Laws from the University of Edinburgh. He was born in Edinburgh in 1847.

MR. C. F. McGILVRAY, president and treasurer of the Robbins & Myers Company, Springfield, Ohio, electrical manufacturers, has been in New York during the past week.

MR. LEWIS CASS LEDYARD has been appointed a member of the Rapid Transit Commission by Mayor McClellan, of New York city, succeeding John Claflin, resigned. Mr. Ledyard is a lawyer, and a member of the firm of Carter, Ledyard & Milburn, of 54 Wall street, New York city.

MR. GEORGE CAMPBELL, president of the Germania Electric Lamp Company, Harrison, N. J., sailed for England on the Carmania on the 8th inst. Mr. Campbell goes abroad to make further arrangements for handling the English end of this company's business, which is reported to be in a very active condition.

MR. THOMAS A. EDISON, accompanied by his brother-in-law, J. N. Miller, Frederick Ott and George Poppe, started on a long automobile trip in two automobiles from West Orange, N. J., on May 16. The party carried a complete camping outfit, and will camp on the way to North Carolina, where quite a stop will be made.

MR. H. C. BAKER, formerly in charge of the Atlanta (Ga.) office of the Crocker-Wheeler Company, Ampere, N. J., will take charge of the Pacific coast territory. The company's offices at Fremont and Howard streets, San Francisco, were completely destroyed by the fire, and temporary offices have been established at 2611 Broadway.

MR. H. F. STEVENS, who has been vice-president and general manager of the Central New York Telephone and Telegraph Company, the Empire State Telephone and Telegraph Company, and the New York & Pennsylvania Telephone and Telegraph Company, has resigned as general manager, but continues as vice-president of each company, and in addition becomes vice-president of the Hudson River Telephone and Telegraph Company. Mr. Stevens' headquarters will be continued at Syracuse, N. Y. Mr. Walter W. Nicholson has been promoted from general superintendent of the Central New York and Empire State companies to succeed Mr. Stevens as general manager of both, with headquarters at Syracuse. Mr. L. S. Greenleaf has been promoted from general superintendent to general manager of the Hudson River company, and the same advancement is made in the case of E. B. Rogers, of the New York & Pennsylvania company. B. C. Wolverton, who has been chief engineer of the Central New York and Empire State companies, becomes chief engineer also of the Hudson River company, with headquarters at Syracuse.

MR. FREDERICK P. FISH, president of the American Telephone and Telegraph Company, addressed the members of the Merchants and Manufacturers' Association and the Citizens' Business League at Milwaukee, Wis., on Wednesday evening, May 9, during the reception tendered to the business men at the Grand Exchange by the Wisconsin Telephone Company. In his address Mr. Fish declared that a reduction of the cost of telephone service was coming, along with the advancement of the facilities and the increase in the number of subscribers. The guests of the company, under escort of President Alonzo Burt, made a tour of the new headquarters and inspected the apparatus. The receiving party was composed of the following: President Alonzo Burt, directors Ira B. Smith, Julius O. Frank, Edward A. Uhrig, Oliver C. Fuller, F. P. Fish, president of the American Telephone and Telegraph Company; Arthur D. Wheeler, president of the Chicago Telephone Company; Casper E. Yost, president of the Nebraska Telephone Company, and John D. McLeod, vice-president; E. P. Cottrill, general manager, and M. J. Carney, assistant to the president of the Wisconsin Telephone Company.

ELECTRICAL SECURITIES.

Last week's stock market was characterized principally by professional dealings and an irregular and mainly sagging price movement. The hopes for a spring boom this year have now been largely ended. The narrowing of speculation, and especially the slackening of outside public participation are regarded as significant of the outlook in this direction. Of first importance in determining the stock market's future is the crop outlook and final harvests. The crop season has opened well, with the May promise of a winter wheat yield the second or third largest on record. Total merchandise exports in April were $141,494,909, against $128,575,374 a year ago, the largest for any April on record. Imports in April were $107,321,038, against $95,110,283 a year ago, not only the largest for any April, but only exceeded by three months in our history.

ELECTRICAL SECURITIES FOR THE WEEK ENDING MAY 19.

New York:	*Closing.*
Allis-Chalmers common	21
Allis-Chalmers preferred	56
Brooklyn Rapid Transit	83½
Consolidated Gas	137½
General Electric	167
Interborough Rapid Transit	227
Kings County Electric	150
Mackay Companies (Postal Telegraph and Cables) common	71½
Mackay Companies (Postal Telegraph and Cables) preferred	73½
Manhattan Elevated	153
Metropolitan Street Railway	112¾
New York & New Jersey Telephone	140
Western Union	92¼
Westinghouse Manufacturing Company	156

The directors of the Kings County Electric Light and Power Company have declared the regular quarterly dividend of 2 per cent, payable June 1. Books closed May 22 and will reopen June 1.

The common shares of the Mackay Companies have advanced 20 points since last December, and are now selling around $72 per share, which compares with $39 per share at the time of organization in December, 1903.

The income account of the New York City Railway Company for the quarter ending March 31, 1906, is as follows: gross, $3,960,771; expenses, $2,398,458; net, $1,562,313; other income, $301,044, a total of $1,863,357; charges, $2,789,724, leaving a deficit of $926,367, as compared with $1,322,406 for the corresponding quarter of 1905.

Boston:	*Closing.*
American Telephone and Telegraph	137½
Edison Electric Illuminating	246
Massachusetts Electric	65½
New England Telephone	137
Western Telephone and Telegraph preferred	89

For the first time in its history the output of instruments of the American Telephone and Telegraph Company, for a given month, has exceeded 200,000, the April gross amounting to 206,557 instruments. The largest previous gross output was that of October, 1905, when 193,272 instruments were put out. Last month was also the record month for net output, which amounted to 141,200, the best previous month being November, 1905, with 134,395.

Philadelphia:	*Closing.*
Electric Company of America	11
Electric Storage Battery common	71½
Electric Storage Battery preferred	71½
Philadelphia Electric	8
Philadelphia Rapid Transit	25½
United Gas Improvement	82

Chicago:	*Closing.*
Chicago Telephone	122
Chicago Edison Light	149
Metropolitan Elevated preferred	68
National Carbon common	90
National Carbon preferred	120¾
Union Traction common	4
Union Traction preferred	12

TELEPHONE AND TELEGRAPH.

WILMINGTON, DEL.—A telephone line has been built from Rising Sun to Zion.

NEWARK, N. J.—A new telephone line from Belvidere to Delaware is to be built.

DUNKIRK, N. Y.—The Fredonia Home Telephone Company is about to make extensive improvements both to its long-distance and local service.

SIOUX CITY, IOWA—The Western Union Telegraph Company has completed a new wire from Sioux City direct to Cedar Rapids, Marshalltown and Ames, Iowa.

MEDICAL LAKE, WASH.—A telephone company at Medical Lake, formerly a mutual concern with twenty-seven telephones, has been incorporated and is putting in a modern system.

DURANGO, COL.—An additional telephone line will be built from Durango to Denver. Another short circuit will also be established this summer between Durango and Ouray *via* Silverton.

SPOKANE, WASH.—The Tumalum Mutual Telephone Company has been organized at Freewater, Ore., and a line will be built between that place and Walla Walla. F. J. Bodefelt is president.

POCAHONTAS, W. VA.—Enough money has been subscribed to build forty miles of the proposed telephone line from Marlinton to Huntersville up Brown's creek. There are now no telephones in that territory.

JOHNSTOWN, PA.—The Bell Telephone Company is building a line to Lemont *via* Coolspring. This line will be the only one reaching that section, which has hitherto been unavailable by telephone, except over the Frick Company's private lines.

FARGO, N. D.—Farmers in the vicinity of Blue and Ottofy are preparing for building a telephone line this summer to the new town of Osago. Probably it will be extended to McVille next fall and there connect with the Red River Valley Telephone Company.

SCHENECTADY, N. Y.—On account of increasing business the capacity of the Hudson River Telephone Company's local exchange will be doubled. Four new sections will be added to the switchboard which will give an additional capacity of about 3,000 telephones.

NASHVILLE, TENN.—The stockholders of the East Tennessee Telegraph Company at their annual meeting elected the following board of directors: R. C. Clowry, J. C. Barclay, J. B. Van Every, G. W. Atkins, New York; J. Levin, Atlanta; J. R. Terhune and A. H. Stewart, Nashville.

FREDONIA, N. Y.—The Home Telephone Company has secured rights of way and has begun work on a new copper toll line from Fredonia to Cassadaga, a distance of ten miles. At that place the line will meet the Inter-Ocean line to Jamestown, making a direct line from Fredonia to Jamestown.

MIDDLETOWN, N. Y.—At the annual meeting of the Farmers' Telephone Company, of Sussex, the old board of directors was re-elected, as follows: W. D. Haggerty, F. E. Armstrong, J. Irving Brink, William Ayres, Joseph Ayres, C. J. Stanaback and Raymond Coursen. W. D. Haggerty was elected president.

UNION, N. Y.—Preparations are being made by the Bell Telephone Company to construct a local telephone system in Union, Endicott and Vestal. It is understood that the right of way has been secured to erect poles on the streets of the three villages, and that the work of constructing the line will be begun in a few weeks.

EAST LIVERPOOL, OHIO—It is said the National Telephone Company, which purchased the Phœnix telephone lines in Steubenville and vicinity, proposes to spend nearly $100,000 in rebuilding and improving the system. The company will place entirely new systems in Toronto and New Cumberland, and will penetrate new rural sections.

READING, PA.—George W. Beard & Company have been awarded the contract for the erection of a large three-story brick annex to the building of the Pennsylvania Telephone Company. It will be of fireproof construction, and twenty-five by ninety feet in dimensions. Work on the building will start at once and will be pushed to speedy completion.

SALT LAKE CITY, UTAH—A report is current that the Union Pacific and the Southern Pacific roads are about to construct an independent long-distance telephone line from Omaha, Neb., to San Francisco, Cal. The line will be a copper metallic circuit, and it will be entirely distinct from the telegraph system of the companies, using its separate line of poles.

COLUMBUS, OHIO—At the annual meeting of the Columbus Automatic Telephone Company the following directors were elected: Clarence Brown, Toledo, Ohio; F. B. Gordon, L. G. Bowers, John T. Norman, Rhodes Browne, B. T. Brooks, J. W. Blackmon, Banks Yonge, E. W. Wood, J. B. Huff and T. E. Blanchard, of Columbus. The company's officers reported a successful year.

NEW ULM, MINN.—The annual meeting of the New Ulm Rural Telephone Company was held recently. The company spent $54,000 during the past year installing an exchange in New Ulm, and building rural lines in the various towns adjoining. The officers elected for the ensuing year are: president, Philip Leisch; vice-president, Alex. Russell; secretary, F. H. Krook; treasurer, Otto Schell.

ELMIRA, N. Y.—The Bolivar Telephone Company has sold a controlling interest in its plant to the Bell Telephone Company. The plant was valued at $28,000. The Bolivar company was organized four years ago and owns and operates exchanges in Bolivar, Shingle House and Allentown and had stations at a number of smaller towns. In all the company has 700 subscribers and 150 miles of pole lines. J. P. Herrick is president of the newly organized company.

SCHENECTADY, N. Y.—At the annual meeting of the stockholders of the Schenectady Home Telephone Company the entire board of directors was reelected for another term of one year. It is as follows: Charles F. Veeder, Evans S. Kellogg, H. C. Hequenbourg, H. E. Webster, A. J. Quackenbush, James M. Andrews, Charles E. Palmer, James McNaughton, Howard Hendrickson, Samuel B. Rawson, Theodore M. Brush, Irving H. Griswold, Frederick H. Sudro, J. W. Smitley, Homer Strong.

WYMORE, NEB.—At a meeting of the city council of Wymore an ordinance was passed repealing the franchise of the New Home Telephone Company, which recently entered that city. When the company secured the franchise J. Harry Myers, a representative of the company, is said to have agreed to connect the farmers' lines running to Wymore with the Home central station, put in automatic telephones and build a central station to cost $3,000. The repeal is based on the alleged failure of the company to comply with its part of the agreement. It is given thirty days to remove its lines and poles from the streets.

INDIANAPOLIS, IND.—The Home Telephone and Telegraph Company, of Fort Wayne, has filed with the secretary of state a notice of increase of its capital stock from $250,000 to $600,000, the new issue of $250,000 being cumulative preferred stock, which will bear six per cent interest. Along with the notice of increase of the capital stock was one which stated that the company had decided to extend its field of operations so as to cover these counties in Indiana: Miama, Cass, Noble, Whitley, Huntington, Allen, Lagrange, Wells, Adams, Howard, Wayne, Elkhart, Wabash, St. Joseph, Steuben, Marshall, Kosciusko, Fulton, Marion, Grant, Blackford, Jay, Tipton, Madison, Delaware, Randolph, Pulaski and DeKalb.

COHOES, N. Y.—At the annual meeting of the stockholders of the Cohoes & Waterford Home Telephone Company the following directors were reelected for the ensuing year: James H. Shine, John Clute, Frederick W. Kavanaugh, Irving N. Griswold, Frederick N. Sudro, Thomas Breslin, George H. Fitts, Paul H. Andrae, Samuel B. Rawson, Theodore M. Brush and Howard Hendrickson. The report of the president showed 950 telephones in use in Cohoes, Watervliet, Crescent and the rural districts. The number gained over last year was 152. The treasurer's statement showed the finances of the company to be in good condition, with a substantial surplus from operations during the past twelve months. The lines have been extended during the past year in Colonie and in the vicinity of Crescent.

OBITUARY NOTICE.

WILLIAM THOMAS BOUCHELLE, secretary to C. F. Cutler, president of the New York Telephone Company, died suddenly at his home at Rock Ridge, in Greenwich, Ct., on the evening of Saturday, May 19. Mr. Bouchelle was taken ill on Thursday evening and could not rally. He was born in Baltimore, Md., fifty-eight years ago. He is survived by a widow. Mr. Bouchelle was well known in electrical circles, and was a prominent member of the Fairfield County Golf Club and the Indian Harbor Yacht Club. His death will be deeply deplored by a host of friends and acquaintances.

NEW INCORPORATIONS.

RICHMOND, VA.—Renan Telephone Company, Level Run. $5,000.

LANSING, MICH.—Chapin Mutual Telephone Company, Fenmore. $1,000.

COLUMBUS, OHIO—Sandy Valley Traction Company. Increased from $8,000 to $112,000.

COLUMBUS, OHIO—Lorain & West Virginia Railway Company, Cleveland. Increased from $10,000 to $2,000,000.

SPRINGFIELD, ILL.—Elgin Merchants' Light Company, Elgin. $2,500. Incorporators: John H. Stickling, John Reinert and Frank Stickling.

SAN BERNARDINO, CAL.—Barnwell & Searchlight Railroad. $500,000. Directors: A. G. Wells, I. L. Hibbard, W. H. Brewer, G. A. Davidson and G. A. Holterhoff, Jr.

SPRINGFIELD, ILL.—Home Light and Power Company, Galesburg. To operate a heat, light and power plant. $10,000. Incorporators: W. S. Cameron, Harry Gardt and I. S. Callender.

MADISON, WIS.—The Milwaukee, Rockford & Eastern Railway Company. To build seventy miles of road in Milwaukee, Waukesha, Walworth and Rock counties, from Milwaukee to Beloit. $100,000.

GUTHRIE, OKLA.—The Star Rural Telephone Company, Parkland. $10,000. Incorporators: Henry Rowland, J. E. Switzer and D. L. Lamb, of Parkland; G. W. Braden, of Chandler; Frank George, of Agra.

LINCOLN, NEB.—The Southeastern Nebraska Telephone Company, Falls City. $100,000. Incorporators: J. H. Miles, W. S. Korner, Edwin H. Yowle, P. B. Weaver, A. E. Kannt, J. H. Morehead and G. W. Duerfeldt.

GUTHRIE, OKLA.—The Alpha Mutual Telephone Company, Rock Falls township, Kay county. $1,000. Incorporators: Ed. Lindsay, D. F. Gilmer, J. Burgett, T. M. Gray, J. O. Lucas, Kay county. Post office address, Hunnewell, Kans.

LARAMIE, WYO.—The Medicine Bow Telephone Company. To build a telephone line among the ranches of northern Albany and Carbon counties. $10,000. Incorporators: Carl Sieverts, R. N. Cronberg, O. P. Reed, J. H. Bowles and A. C. Cooper.

INDIANAPOLIS, IND.—The A. & G. Telephone Company. To operate telephone exchanges in Vanderburg, Posey and Gibson counties. $5,000. Officers: Cornelius Roeder, president; Christ. Goeble, vice-president; Louis A. Haas, secretary; Christ. Strupp, treasurer.

HARRISBURG, PA.—Rush Township Electric Light, Heat and Power Company, Phillipsburg; $5,000. Decatur Township Electric Light, Heat and Power Company, Phillipsburg; $5,000. Chester Hill Electric Light, Heat and Power Company, Phillipsburg; $5,000.

INDIANAPOLIS, IND.—The Central Railway Company, of Indiana. To build an electric line encircling Indianapolis and passing through Hendricks, Boone, Morgan, Johnson, Shelby, Hancock and Marion counties, 100 miles. Charles H. Burras, of Chicago, owns all but fourteen shares of the stock. $100,000.

ALBANY, N. Y.—The Quantuck Electric Company. To manufacture and use electricity for light, heat and power in the towns of Southampton, Brookhaven and Riverhead, Suffolk county. $100,000. Directors: Everett B. Sweezy, S. A. H. Dayton and George S. Macdonald, of New York city, and William H. Sweezy and Robert P. Griffing, of Riverhead.

DELAWARE, OHIO—The Galion, Mount Gilead & Delaware Electric Railway Company, Galion. To construct and operate an electric railway running from Galion through Crawford, Morrow and Delaware counties. $10,000. Incorporators: John McNeal, Newton Ruhl, W. P. Vaughn, S. P. Gage, W. M. Carlisle, C. L. Russell, J. G. Russell, Oscar A. White and Harry D. Griffith.

ATLANTA, GA.—The Dalton-Allendale Railway Company. To run from Dalton in an easterly direction, crossing the Louisville & Nashville Railroad at Challsworth in the county of Murray, and thence in the same direction to Allendale at or near the foot of Fort Mountain in Murray county. $500,000. Incorporators: John D. Follette, of Cincinnati; Robert L. Wayman, of Chattanooga; J. F. Allen, of Murray county, Ga.; J. M. Sanders, J. A. Longley, M. H. Williams, W. R. Cannon, W. M. Sapp, H. C. Hamilton, J. K. Farrar, H. B. Farrar and F. F. Farrar, of Dalton, Ga.

ELECTRIC RAILWAYS.

SPOKANE, WASH.—It is announced that the Spokane & Inland Railway is to be extended to Pullman at an early date.

NEW CASTLE, PA.—The trolley line from New Castle to Harmony and Pittsburg will be completed this summer if possible.

SPOKANE, WASH.—Farmers on Peone prairie are securing right of way for an electric road from Spokane. The proposed road is to be about fifteen miles long.

ST. JOSEPH, MO.—A preliminary survey for a right of way between Kansas City and St. Joseph for the projected Kansas City, St. Joseph & Excelsior Springs Railway has been completed.

OGDEN, UTAH—The Utah Light and Railway Company has entered into a contract with the Ogden Rapid Transit Company to furnish the latter with electric power for the running of its street cars in Ogden.

MUSKEGON, MICH.—Following a meeting of the West Michigan Interurban Company it was announced that eastern capitalists have agreed to advance $750,000 to build an electric road from Muskegon to Hart. Surveys have been made and franchises secured.

SCRANTON, PA.—The new Ridge Row Railway Company has been granted permission to extend its lines by the commonwealth. The company has already been granted state rights to construct a road *via* Ridge Row, leading to a point near the new Luna Park at Nayaug.

WILMINGTON, DEL.—The directors of the company which is to build a trolley line connecting Wilmington and Elkton, Md., have deposited $1,000 with the Cecil county commissioners, the guaranty required, in consideration of a franchise granted to use roads in that county. The agreement, it is understood, is that the road is to be completed and in operation in Cecil county by October.

PERU, IND.—Work on the Peru & Warsaw branch of the Winona interurban line will soon be commenced. The company has leased ground upon which to store material, and 150 tons of new steel and 10,000 ties are now *en route* to Peru for use in connecting the city with the Peru & Chili branch of the Wabash railroad, two miles east of the city.

LISBON, OHIO—N. B. Billingsley, president of the Pittsburg, Lisbon & Western Railroad Company, has officially confirmed the rumored transfer of the company's Salem & Washingtonville line to the Youngstown & Ohio River Railway Company, which proposes to utilize it as a link in its electric railway system between Youngstown and East Liverpool.

PHILADELPHIA, PA.—The Philadelphia Rapid Transit Company has placed an order with the J. G. Brill Company for 100 new cars at an estimated cost of $400,000. Deliveries are to begin September 1. This will increase the company's equipment to 1,800 cars, not including the cars to be operated on the elevated and subway, which are scheduled to be opened October 1.

BALTIMORE, MD.—The gross earnings of the United Railways and Electric Company for the quarter ended March 31, 1906, amounted to $1,411,903. The gross earnings for the year ended December 31, 1905, amounted to $6,023,698. The earnings this year are expected to be far in excess of those of 1905, as the company has enlarged its equipment and several resorts will be opened on its lines this summer.

TEMPLE, TEX.—At a mass meeting of citizens $100,000 was pledged in aid of the construction of an interurban electric road forty miles in length, connecting Temple and several small intermediate towns with Marlin Springs. One-half is to be a cash bonus and the balance a subscription to an issue of first mortgage bonds. J. C. Houser, of Pennsylvania, is at the head of the enterprise. Surveys have been made.

UNIONTOWN, PA.—A franchise has been granted by the Uniontown borough council to the Uniontown & Bridgeport Street Railway Company promoted by John S. Scully and J. S. Rodgers, of Pittsburg. The company is to build a trolley line between Uniontown and Brownsville, and has given bond for $20,000 to have the line in operation within eighteen months. The granting

of the franchise was opposed by the West Penn Company, which claims to have a state charter covering the same route.

SEYMOUR, IND.—Joseph I. Irwin and William G. Irwin, of Columbus, have announced the route over which their traction line will be extended to Seymour. The road will be constructed on the east side of White river through Azalia and Reddington. Material for this extension of twenty miles has been ordered, and contracts for grading will be let at once. Construction work will probably begin this month.

BOULDER, COL.—It is stated, on what is considered good authority, that the Colorado & Southern company will electrify its road between Denver and Boulder and perhaps further north, and will secure power from the Westinghouse company, which is backing the Henry deal in the purchase of the Boulder Electric Light and Power Company's plant, and which is to put up a $1,000,000 electric plant at or near Lafayette.

BELOIT, WIS.—Beloit and Chicago business men have organized the Beloit Traction Company and will apply for a franchise. The capital stock, $50,000, has been subscribed. The officers are: J. B. Dow, Beloit, president; C. A. Gault, Beloit, vice-president; O. S. Baylies, Chicago, secretary and treasurer. The company proposes to build six miles of track, and the system will be operated in conjunction with the Rockford, Beloit & Janesville interurban.

VINCENNES, IND.—The Vincennes Street Railway Company has been merged with the Vincennes Traction and Light Company, which expects to run interurbans to Sullivan *via* Bruceville, Bicknell and Freelandville to Washington and to Princeton. The capital stock of the new company is $600,000. B. G. Hudnut, of Terre Haute, is president; C. A. Gordon, of Terre Haute, secretary; George E. Henry, of Vincennes, vice-president and general manager, and these, with William Foley, of St. Louis, and Maurice Hudnut, of Terre Haute, are directors.

NEW ORLEANS, LA.—The Bayou Teche Traction and Power Company has been granted a charter to build an electric line from New Iberia through St. Mary, Iberia and St. Martin parishes. It has a capital of $1,500,000, with the following officers: A. F. Augur, president; R. H. Fine, vice-president; J. T. White, secretary, and Ledoux Smith, treasurer. The company has been organized for the purpose of building an electric street car line to New Iberia proper, and extending it along Bayou Teche to Morgan City, Franklin and Patterson. In the other direction it will run to St. Martinsville, which is at the head of navigation of the teche. It is also the intention of the promoters to establish a small electric street car line in each of the said cities through which the road will pass.

CUMBERLAND, MD.—The consolidation and merger of the Cumberland & Westernport Electric Railway, the Westernport & Lonaconing Electric Railway and the Lonaconing, Midland & Frostburg Electric Railway, embracing thirty-two miles of trolley line from Cumberland to Piedmont, through the entire length of the George's Creek mining region, has been effected. De Warren H. Reynolds is president of the Cumberland & Westernport Electric Railway, and will continue in that capacity for the entire system, which will be known as the Cumberland & Westernport Electric Railway. The merger was authorized by act of 1902. The Westernport & Lonaconing Railway Company acquired by purchase the Morrison's Land Company's property at Reynolds, which includes a valuable coal mine, a park with casino and a number of houses. Here, too, is located a power-house. The acquisition was made on April 21, 1906, under the exercise of the provisions of an act passed at the last session of the legislature, and the new holder entered into an agreement to guarantee the payment of its coupon bonds and interest.

ENGINEERING SOCIETIES.

TORONTO BRANCH OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—At the annual meeting of the Toronto branch of the American Institute of Electrical Engineers, held on Friday, May 11, at the Engineers' Club, Toronto, Ontario, the following officers were elected for the season of 1906-1907: chairman, R. G. Black; vice-chairman, K. L. Aitkin; secretary, R. T. MacKeen. Executive committee: W. A. Buck, H. W. Price, W. G. Chase. The following motion was unanimously adopted: "That during the season 1906-1907 there be held one meeting per month, on the second Friday of each month, at the Engineers' clubrooms, 96 King street, West."

INDUSTRIAL ITEMS.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., is distributing a handsome booklet describing its new shop and laboratory and giving a number of views of different departments.

THE AMERICAN TRANSFORMER COMPANY, Newark, N. J., has published a new catalogue describing the "American" transformer. The text is complete and the illustrations are well made.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., announces that in addition to the office established at 906 Broadway, Oakland, Cal., the company has opened quarters in the Atlas Building, 602 Mission street, "New" San Francisco, Cal.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY'S San Francisco office which is now occupying temporary quarters in the Blake Block, Oakland, Cal., announces that it will move next week into rooms 403, 404 and 405 Atlas Building, 604 Mission street, San Francisco.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., in bulletin No. 96 describes and illustrates the application of storage batteries to lighting and power plants, particularly for residential installations. This bulletin shows a number of views of residences in which these batteries have been installed.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in bulletin No. 65 describes and illustrates core-type transformers for high-tension power transmission. These transformers contain many important features of design and are said to represent a long step in advance in transformer construction.

THE S. H. COUCH COMPANY, INCORPORATED, Boston, Mass., will be pleased to send bulletin No. 14, descriptive of exchange telephone apparatus, construction material and accessories, to any one interested upon request. This little bulletin is replete with interesting information and illustrations concerning this apparatus.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has established temporary offices at 67 Blake Block, Oakland, Cal. The company will, however, occupy rooms at 403, 404 and 405 Atlas Building, San Francisco, Cal., as soon as that building is ready for occupancy. The company has also replaced its stock, which was destroyed by fire.

THE SPRAGUE ELECTRIC COMPANY, New York city, reports a constantly growing demand for its flexible conduits and armored cables, manufactured under the Greenfield patents. Last month was a banner month in total sales. The Sprague company's conduits were among the first placed upon the market, and to-day represent the latest advances in modern electric wiring installation.

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, St. Paul, Minn., is desirous of purchasing second-hand electrical apparatus in the form of dynamos and motors, arc lamps, meters, transformers and electrical instruments. Cash payment is offered, and the commercial rating bureaus are referred to for responsibility. The manager of this company is Mr. J. D. Zook, formerly superintendent of the Gregory Electric Company, Chicago, Ill.

THE MURRAY IRON WORKS COMPANY, Burlington, Iowa, has published a handsome catalogue describing Corliss engines, air-compressors, pumping engines, tubular, water-tube and internal furnace boilers, feed-water heaters and complete power plants. This company was incorporated February 1, 1870. Its plants are located in Burlington and West Burlington, Iowa, and at Aurora, Ill. The catalogue is well illustrated with sectional drawings and reproductions of typical installations.

MR. V. C. GILPIN, manufacturers' agent, 120 Liberty street, New York, has accepted the sales agency of the metropolitan district for the products of the American Conduit Manufacturing Company. Mr. Gilpin is one of the best known salesmen in the electrical industry, and he is now establishing this agency, devoting it entirely to the handling of electrical equipments and specialties. His office now acts for the following companies: Tower-Binford Electric Manufacturing Company, the Scranton Button Company and the American Conduit Manufacturing Company.